SCIENCE ABSTRACTS.

Section A.—PHYSICS.

APRIL, 1929.

GENERAL PHYSICS.

1016. Pilot Balloon Slide Rule. F. J. W. Whipple. *Journ. Sci. Instruments*, 5. *pp.* 345–348, *Nov.*, 1928.

This pattern has been introduced for use with the tail method of pilot balloon ascents. It has log scales from 1–10^3; sine and cosine scales, one reading to 0·5° to 90° and the other 10° to 90°, the graduations 0°–20° being arranged on an arc; a tangent scale reading 3°–84°; a graticule scale running the opposite way to the log scale and a secant square scale. This rule can also be used for the two-theodolite method, and is useful for other trigonometrical work. R. S. R.

1017. Testing Instruments for Yarns and Fibres. W. S. Denham and T. Lonsdale. *Journ. Sci. Instruments*, 5. *pp.* 348–354, *Nov.*, 1928.

1. A ballistic instrument for measuring the work done in breaking a thread or bundle of filaments is described. The thread is mounted between two clamps, one of which is incorporated into a pendulum at its centre of percussion, the other rests on a ledge on the pendulum, the instrument being contrived so that this clamp is caught on fixed projections when the pendulum is at the lowest part of its swing. The energy absorbed in breaking a thread is measured in terms of the consequent decrease of the arc of swing of the pendulum after falling from a definite height.

2. The extensometer described gives load-extension diagrams of single ultimate filaments of silk. Tensions on the filament under test produce torsions on a steel blade; these are recorded by the consequent deflections in a vertical plane of a beam of light which falls on a photographic film. The elongations of the filament corresponding to these tensions are proportional to the (corrected) horizontal movements of this film, which records load-extension diagrams with rectangular coordinates. AUTHORS.

1018. Density and Temperature. W. Herz. *Zeits. f. Elektrochem.* 34. *pp.* 857–858, *Dec.*, 1928.

Referring to papers by R. Lorenz and himself, and by Klemm [see Abstract 209 (1929)], on the approximately constant ratio of the mole volume of the solid salt to that of the liquid at the melting point, the author compares the densities of liquids and their saturated vapours at nine-tenths of the critical temperature. This density ratio is approximately 10 for many organic and also inorganic compounds; it rises to 14 in some alcohols (strongly associated) and sinks to about 8 for substances like oxygen and chlorine of low critical temperatures. At two-thirds of the critical temperature the ratios (liquid over vapour) become larger and less regular. H. B.

1019. Diffusion of Non-Spherical Particles. R. Gans. *Ann. d. Physik*, 87. 7. *pp.* 935–947, *Dec.* 8, 1928.

The quantitative study of the diffusion of non-spherical particles in a solvent gives an indication of the size and shape of the particles. The author bases his treatment on the theory of Brownian motions of non-spherical particles. He works out a graphic solution which gives the sizes and the ratios of axes of particles which can be regarded as ellipsoids of rotation. E. E. F. d'A.

1020. Variation of Young's Modulus with Temperature: Steel, Palladium, Elinvar. A Jaquerod and H. Mügeli. *Helv. Phys. Acta*, 1. 2. *pp.* 139–164, 1928. *In French.*

The method employed was to furnish a chronometer with a spring of the material under test and a disc balance wheel whose expansion was known, and to determine its rate at various temperatures. In the case of steel, measurements were made from − 184° C. to 100° C., and the results are represented by the formula $E/E_0 = 1 - 10\cdot1754 \times 10^{-6}T^{1\cdot5}$. For Pd (alloy, Pd + 20 % Cu) measurements were only possible from 0° C. to 80° C. The mean coefficient is 0·00030. For elinvar there was considerable variation between different specimens, but the changes were much smaller. W. G. B.

1021. Equations for the Transverse Vibrations of Thin Rods. H. Bateman. *Messenger of Math.* 57. *pp.* 145–154, *Feb.*, 1928. *Abstract.*

Solutions satisfying a certain type of boundary condition are sought. Inversion formulæ for the integral expressions obtained are suspected, and are shown to be true in certain cases. Their limitations are not yet thoroughly found. W. G. B.

1022. Energy of Deformation of an Elastic Solid. F. D. Murnaghan. *Nat. Acad. Sci., Proc.* 14. *pp.* 889–891, *Nov.*, 1928.

By keeping the quadratic terms in the expression for the increase in length of an element when strained, and consequently in the expressions for the strain components, and then assuming that the strain-energy function is a function of these alone, it is deduced that it must be a function of three symmetrical stress invariants. The assumption that the strain-energy involves only the strain-components thus seems incompetent to include anisotropic solids. W. G. B.

1023. Centric and Eccentric Stability of Steel Rods under Pressure. E. Chwalla. *Akad. Wiss. Wien, Ber.* 137. 2*a*. *No.* 8. *pp.* 469–512, 1928.

This paper records an investigation of steelwork used in buildings. The behaviours of rods of various shapes under different stresses are very thoroughly examined and accompanied by the appropriate mathematical treatment. The paper, however, is too detailed for an abstract, and should be consulted in its entirety. H. H. Ho.

1024. Compressibility of Thallium Indium and Lead. T. W. Richards and J. D. White. *Am. Chem. Soc., J.* 50. *pp.* 3290–3303, *Dec.*, 1928.

The thallium and indium were carefully purified (details given), and the lead used was a very pure specimen previously employed for the same purpose, the compressibility of which was redetermined as a check. The method is essentially the same as in previous determinations, a glass piezometer being used. The following results were obtained, the pressure limits being 100–500 megabars:

Substance.	Temp. °C.	Density.	Compressibility, *i.e.*, $(\Delta V/V)/\Delta P$.	
			As now determined.	Previous Results.
Toluene	24·84	0·8116	70·9	69·0 at 20°
Lead	25	11·346	2·40	2·35 at 20°
Thallium	25	11·85	2·83	2·85 at 20°
In-Zn alloy, 3 % Zn	25	7·292	2·51	—
Indium	25	7·296	2·55	2·70 at 25°

Tables and curves are also given comparing atomic volumes with compressibility, thermal pressure, internal pressure and rate of change of internal distending pressure according to Richards' equation of state for the above elements and their neighbours in the atomic series, showing substantial interrelations. C. A. S.

1025. Compressibility of Sodium, Barium and Beryllium. T. W. Richards, L. P. Hall and B. J. Mair. *Am. Chem. Soc., J.* 50. *pp.* 3304–3310, *Dec.*, 1928.

The barium used was 99·9 % pure, and the beryllium over 99 %; the strontium contained some hydroxide, and the result is only preliminary. As a check the compressibility of pure sodium was determined. The method used was essentially the same as in previous determinations, save that the piezometer was of pyrex instead of soft glass, and the taper of the stopper increased to 1 in 8 to prevent sticking. An ingenious method for determining the weight and density of barium, applicable to all such easily oxidisable metals, is detailed. The following results were obtained, pressure limits being 100–500 megabars:

Metal.	Temp. °C.	Density.	Compressibility, *i.e.* $(\Delta V/V)/\Delta P$.	
			As now determined.	Previous Results.
Sodium..............	25	0·972	15·6	15·6 at 20°
Barium..............	25	3·66	10·48	10·19 at 30°
*Strontium	25	2·74	7·22	8·187 at 30°
Beryllium..............	25	1·85	0·93	0·855 at 30°

* Containing some hydroxide.

C. A. S.

1026. Anticlastic Bending of Rectangular Bars. A. Ferguson and J. P. Andrews. *Phys. Soc., Proc.* 41. *pp.* 1–16; *Disc.*, 17, *Dec.*, 1928.

This paper describes a method for the survey of the surface of a beam bent by couples, with special reference to the study of the curvatures in and perpendicular to the plane of bending. AUTHORS.

1027. New Equation for the Determination of Surface Tension from the Form of a Sessile Drop or Bubble. N. E. Dorsey. *Washington Acad. Sci., J.* 18. *pp.* 505–508, *Nov.* 19, 1928.

The method of determining surface tension from measurements of a sessile drop or bubble, though not of as high accuracy as other methods, is specially valuable when it is desired to determine the progressive change in surface tension, photographs being taken at suitable intervals. Existing formulæ being difficult to use and giving results of insufficient accuracy, the author proposes the following: $T/g(d - d') = r^2(0 \cdot 052/f - 0 \cdot 12268 + 0 \cdot 0481f)$, where T = surface tension; g = acceleration of gravity; $d - d'$ = positive difference in densities of the fluids separated by the surface; r = radius of maximum horizontal section of drop; $f = a/r - 0 \cdot 41421$, where a is the intercept on the vertical through the highest point of the drop between that point and the intersection of that vertical with a tangent to the drop inclined at 45° thereto. For a drop of water 0·8–1·7 cm. in diameter the formula gives the value of $T/g(d - d')$ correct to within approximately ± 0·06 %. C. A. S.

1028. Surface Energy and the Orientation of Molecules in Surfaces as Revealed by Surface Energy Relations. W. D. Harkins. *Zeits. f. phys. Chem.* 139. *pp.* 647–691, *Dec.*, 1928. *In English.*

Deals mainly with work done by the author on the subject. Considers the molecular-kinetic theory of surfaces, and of molecular orientation in surfaces, the effects of entropy and the second law of thermodynamics, the relation between the free surface energy, the total surface energy, the temperature and the latent heat of surface formation. Gives evidence for the orientation of molecules in the surface of a pure liquid from a consideration of the steps in the process of vaporisation, and from the relation between the energy of cohesion and that of adhesion. Deals with films, the spreading of liquids and the spreading coefficient, the thickness of the water film on salt solutions, monomolecular films as the substratum of polymolecular films, and the stabilisation of emulsions by monomolecular soap films. In connection with the first of the two last subjects an account is given of experiments by the author and J. W. Morgan, and for the second by the author and N. Beeman. The results of these last experiments prove that an emulsion may be produced by even an expanded or dilute monomolecular film. H. N. A.

1029. Fundamental Problem in Two-Dimensional Hydrodynamics. N. Mouskhelichvili. *Accad. Lincei, Atti*, 7. *pp.* 995–1002, *June* 17, 1928. *In French.*

The irrotational motion of a liquid, confined or unconfined, is discussed, the fundamental problem considered being to find the component velocities, u, v, being given the series of values of the normal component of the velocity along the boundary in the case of the confined liquid, or the circulation in the case of the unconfined liquid. J. S. G. T

1030. Hydrodynamic Actions in the Neighbourhood of Salients. U. Cisotti. *Accad. Lincei, Atti*, 8. *pp.* 452–459, *Nov.* 18, 1928.

Worked out for angular salients and for rounded salients. A. D.

1031. Bernouilli's Theorem for a Homogeneous Viscous Liquid. M. Lelli. *Accad. Lincei, Atti*, 8. *pp.* 362–366, *Nov.* 11, 1928.

An analytical deduction of this theorem from a general relationship previously developed [see *Annali di Matematica pura ed applicata*, 4. 3. p. 168, 1925–1926]. J. W. T. W.

1032. Wave Pattern of a Doublet in a Stream. T. H. Havelock. *Roy. Soc., Proc.* 121. *pp.* 515–528, *Dec.* 3, 1928.

Recent work on wave resistance having been in good agreement with experiment, the problem of the shape of the water surface in the vicinity of the body is next to be attempted. As a preliminary, detailed calculations of the disturbance due to a submerged doublet have been carried out for two and three dimensions and for two relative depths. W. G. B.

1033. Air Forces at Great Velocities, especially in Plane Streaming. J. Ackeret. *Helv. Phys. Acta*, 1. 5. *pp.* 301–322, 1928. *In German.*

The equations of motion of a compressible fluid (not including the effects of viscosity) are integrated approximately for the flow over a slightly corrugated surface. The pressure as found tends to infinity as $U \to c$ (c = velocity of sound), like $1/\sqrt{(1 - U^2/c^2)}$, and for velocities greater than c is proportional to $1/\sqrt{(U^2/c^2 - 1)}$. W. G. B.

1034. Projectile Resistance. H. Lorenz. *Phys. Zeits.* 29. *pp.* 437–441, *July* 1, 1928.

Reference is first made to an earlier paper on the dependence of air and water resistance on velocity [see Abstract 1088 (1917)] in which the state of motion in the neighbourhood of a solid axially symmetrical body is described. The limitations of the earlier formula, which did not take into account surface friction, are discussed, and new expressions are derived suitable for various shaped projectiles. H. H. Ho.

1035. Action Function of Projectile Motion and its Geometrical-Optical Significance. H. König. *Helv. Phys. Acta*, 1. 4. *pp.* 237–246, 1928. *In German.*

A detailed discussion is given of the oblique projection of a mass particle in the gravitational field, using the action function and Hamilton's principle. The wave-mechanics viewpoint is adopted, and the details of propagation of the phase waves are worked out. The analysis is restricted to two dimensions. W. S. S.

1036. Simple Proof of the Coriolis Theorem. W. Staszewski. *Phys. Zeits.* 29. *pp.* 815–817, *Nov.* 15, 1928.

In view of the difficulties which accompany the usual analytical or vector-analytical proofs of the Coriolis theorem, the author has now submitted a proof, based on dynamic reasoning, which he claims to be free from the ambiguities of former proofs. H. H. Ho.

1037. Spheroidal Harmonics as Hypergeometric Functions. D. M. Wrinch. *Phil. Mag.* 6. *pp.* 1117–1122, *Dec.*, 1928.

The author's treatment by hypergeometric functions covers prolate and oblate spheroids, without necessity for separate discussion of the two cases. It allows very simple approximations to be arrived at in all the usual applications concerning oblate spheroids. It is also possible to construct harmonics suitable for more general cases of surfaces of revolution. H. N. A.

1038. Lattice Dimensions of Spinel ($MgAl_2O_4$). E. Posnjak. *Am. J. Sci.* 16. *pp.* 528–530, *Dec.*, 1928.

From powder photographs taken with a film distance of 8 in. it is deduced that the length of the edge of the unit cube of spinel containing eight molecules is $8 \cdot 03 \pm 0 \cdot 01$ Å. Calculated density, 3·628. W. H. Ge.

1039. Formation of Neumann Bands. Parts I, II and III. S. W. J. Smith, A. A. Dee and J. Young. *Roy. Soc., Proc.* 121. *pp.* 477–514, *Dec.* 3, 1928.

A study of the Neumann lamellæ which are a characteristic feature of hexahedral meteoric iron and of the kamacite of octahedral meteorites. In Part I the mechanism of twinning in the body-centred cubic lattice is discussed. In Part II it is shown that the bands are lamellæ, parallel to the {112} planes, which are in twin orientation with respect to the matrix. Part III deals with the movement from which the twinning results. W. H. Ge.

1040. Metallic Fibre Hair Crystals under X-Ray Examination. R. Schenck, R. Fricke and G. Brinkmann. *Zeits. f. phys. Chem.* 139. *pp.* 32–46, *Dec.*, 1928.

Hair crystals (trichites) of silver were obtained by heating silver foil in contact with solid silver sulphide for four days in a vacuum to 450°; the crystals grow from the silver into the sulphide. The sulphide (selenide or chloride) may also be decomposed by oxidation, reduction or electrolysis, and the reaction may really be thermoelectric; but that would not apply to the organic hair crystals. That solid silver sulphide behaves like an electrolyte, and that the silver ions travel in the solid sulphide 200 times faster than in the liquid was shown by Tubandt and Eggert [see Abstract 1502 (1921)]. For the X-ray examinations the compound fibres, artificial or natural, of silver and copper were separated as far as possible and mounted in picein for rotation. The artificial silver hair crystals showed orientation in a direction parallel to the [112] plane and spots indicating single crystals. On heating to 900° the spots disappeared, and the natural crystals showed random orientation, suggesting subsequent heating or great age. The copper crystals, both artificial and natural, were much less uniform and more spotted. H. B.

1041. Röntgenographic Investigations of Coloured Cellulose. F. Bion. *Helv. Phys. Acta,* 1. 3. *pp.* 165–185, 1928. *In German.*

This röntgenographic examination of dyed ramie, using both inorganic and organic substances as the colouring media, was undertaken in order to give a better insight into the art of dye fixing. The results obtained show that for the elements gold, silver, selenium and tellurium, the inorganic dyes are haphazardly deposited in the ramie thread in the form of submicroscopic crystals. For gold and silver, a partial orientation of the crystals was also observed. Ramie coloured with mercury contained the mercury in liquid form, whilst iodine was apparently adsorbed by the ramie fibre. All the organic substances used appear to be adsorbed in the amorphous form by the micelle surface of the ramie. A variation of the size of the crystallites in the thread occurred, such being mainly produced by coagulation due to the hot salt solution of the dyeing bath. Hot dye solutions alone had no effect on the thread crystals. R. C. F.

1042. Röntgen Diagrams of Cellulose. R. O. Herzog and W. Jancke. *Zeits. f. phys. Chem.* 139. *pp.* 235–262, *Dec.*, 1928.

Natural plant products all give the same diagrams for native cellulose. Cellulose after dispersion to a sol or treatment with nitric acid or caustic soda gives rise to the X-ray diagram of cellulose hydrate. The differences between the diagrams of cellulose and cellulose hydrate are very slight, and can only be explained by assuming that they are due to two modifications of cellulose. Native cellulose probably crystallises in the monoclinic, and cellulose hydrate in the rhombic form. F. J. W.

1043. Photography and Photometry in X-Ray Crystal Analysis. W. T. Astbury. *Phot. J.* 68. *pp.* 500–507, *Dec.*, 1928.

After a brief review of the various types of X-ray crystal photographs, in which are included two Laue photographs, one for a fixed crystal, and the other for a rotating crystal, a Debye-Scherrer " powder photograph " and photographs of rolled aluminium foil and ramie fibre, the author describes a new integrating X-ray microphotometer which gives the total intensity in each of the X-ray reflections. A carbon print stripped from its temporary support is used in place of the original negative, and instead of ordinary light, α-rays from a small deposit of polonium on a piece of foil are used. The α-rays, after passing through the tissue, are caught in an α-ray electroscope, and the rate of fall of the gold leaf becomes a measure of the thickness of the carbon film, and hence the density of the original negative. If the electroscope be in such a position that the α-rays, after passing through the maximum thickness of carbon tissue just do not enter it, then this corresponds to zero X-ray intensity. However, it was found that the curve connecting X-ray and α-ray intensities was a straight line except near the origin. This deviation can be eliminated by suitable electroscope adjustments, provided there is a calibration wedge on the original negative, and the method is shown to be independent of photographic variations. R. C. F.

1044. Accented Terms of Calcium. G. Gentile. *Accad. Lincei, Atti,* 7. *pp.* 910–915, *June* 1, 1928.

A mathematical paper containing calculations, on the basis of Schrödinger's theory, for the special terms known as accented terms of the alkaline-earth metals, especially of calcium. T. H. P.

1045. Structure of Molecules of N_2, O_2, F_2. A. T. Williams. *Univ. Nac. La Plata, Estudio Ciencias, No.* 86. *pp.* 397–406, *Nov.*, 1928. *In Spanish.*

Molecules of N_2, O_2, F_2 are asymmetrical, and are formed of a negative ion, similar in configuration to the Neon atom, the electrical charge of which is equal to the normal valency of the atom considered, added to a positive ion of similar configuration to that of the atoms of Be, C, and O respectively. The similarity with the Neon atom of the molecules of N_2, O_2, and F_2 decreases in the order named. The absorption of light, visible and ultra-violet, increases from N_2 to F_2; the potential of ionisation decreases in the same order; the chemical affinity, null in Ne, is great in F. The symmetry of molecules is discussed, and in accordance with Debye's theory new models of N_2 and O_2 are proposed, which are somewhat different from those above described. O_2 is a dipole with $+\epsilon$ and $-\epsilon$ charges and one binuclear electron, and N_2 has two binuclear electrons and an identical bipole. A. D.

1046. Electronic Symmetry and Polyatomic Molecules. P. Vinassa. *Accad. Lincei, Atti*, **7.** *pp.* **975–979,** *June* **17, 1928.**

Although fluorine, chlorine, etc., which, according to the accepted view, should correspond with a "noble gas ideal," are highly active, nitrogen is perfectly inert. Thus, to nitrogen more than to fluorine should be attributed a quaternary symmetrical structure of the noble gas type. This hypothesis is not, however, in agreement with the facts, and the author considers it more logical to assume in these molecules a centre consisting of the two nuclei carrying a pair of electrons, the remaining electrons being arranged around in quantic orbits. Thus, the fluorine molecule may be represented by (2 + 2) . 2 . 8 . 2 . 2, and the chlorine molecule by (10 + 10) . 2 . 8 . 2 . 2; the oxygen atom will be (2 + 2) . 2 . 8 . 2, which is a symmetrical molecule, but not of the noble gas type, and is hence active. In the nitrogen molecule, (2 + 2) . 2 . 8, however, the two nuclei, with an equilibrium of the helium type, are surrounded by a stable neon arrangement, the molecule being inert. Ozone is to be regarded not as a true allotrope of oxygen, but as a compound of O_2 with O. The cases of sulphur, selenium, tellurium, etc., are also discussed. T. H. P.

1047. Molecular Structure and Chemical Linking. F. Hund. *Phys. Zeits.* **29.** *pp.* **851–852,** *Nov.* **15, 1928.** *Paper read before the Deut. Naturforscher u. Ärzte, Hamburg, Sept.*, **1928.**

Every electronic orbit can only take up a certain maximum number of electrons. The progressive completion of the atom by the addition of electrons may be represented by $1s^2, 2s^2, 2p^6, 3s^2, 3p^6 \ldots$, which means that first two electrons are added to $1s$ orbits, then two to $2s$ orbits, further six to $2p$ orbits, etc.; qualitatively the conditions of all the atoms may be interpreted in this way. Something similar is possible for molecules, as is shown for a two-centre system having two nuclei with several electrons, by investigating whether the nuclei will be in equilibrium at some definite distance. The symbols change into $1s\sigma^2, 2s\sigma^2, 2p\sigma^2, 2p\pi^4, 3s\sigma^2$. The fundamental terms of molecules will be simpler than for atoms, but the electron terms will be more complex already for smaller numbers of electrons. It will therefore be difficult to identify series, and a molecule may have a low excitation energy in spite of a high energy of ionisation. Two separate helium atoms have a very low energy; hence there will be no solid He_2 molecule, whilst a molecule LiH should exist. Reference is made to similar suggestions by Mulliken [see Abstract 63 (1929)]. H. B.

1048. Probability of Impact Transference. E. Fues. *Phys. Zeits.* **29.** *pp.* **852–853,** *Nov.* **15, 1928.** *Paper read before the Deut. Naturforscher u. Ärzte, Hamburg, Sept.*, **1928.**

The intensity relations of the components of a multiplet depend largely upon the conditions of the excitation. Calculations for well-defined impact velocities have been made by G. Hertz [see Abstract 1457 (1924)]. But the explanations do not appear to be applicable when the separation is small compared to the range of the velocity of the hitting electrons. The author considers hit atoms of hydrogen type, presuming their electrons to have a spin like the hitting electrons, but he disregards magnetic interaction, limiting himself to Coulomb forces. A total impulse, comprising orbital impulse and spin, may be formulated on the theory of wave mechanics, either by the proper functions of J. v. Neumann and Wigner [see Abstract 2372 (1928)], or the spherical functions of C. G. Darwin [see Abstract 2897 (1927)]. When a stream of oriented electrons hits oriented atoms, the excitation will be selective; with random orientation the excitation of a close multiplet will depend upon the quanta. Both the amplitudes and the phases of the Schrődinger vibrations must be considered, and there may be an effect of the velocity of impact [see J. R. Oppenheimer, Abstract 2279 (1927)]. H. B.

1049. Inner Friction of Atomic Hydrogen. P. Harteck. *Zeits. f. phys. Chem.* 139. *pp.* 98–106, *Dec.*, 1928.

Describes an apparatus with which the inner friction of a mixture of atomic and molecular hydrogen, and the concentration of the atomic hydrogen in it, can be determined. Since the duration of life of the hydrogen atoms is only a few tenths of seconds, and recombination goes on not only in the gas phase, but also on the walls, it is necessary that the stream of activated hydrogen should pass as quickly as possible from the discharge tube in which it is produced through the tube between the ends of which the fall of pressure is measured. The concentration of the H atoms is arrived at by means of a diffusion effect. The inner friction was found to be $(690 \pm 25) \times 10^{-7}$, the free path 130×10^{-7} cm., the working sectional area of the atoms contained in 1 c.c. under normal conditions $1 \cdot 36_4 \times 10^4$ cm.^{2}. H. N. A.

1050. Existence of a Stable Isotope of Radium in Barium Minerals. O. Hahn and K. Donat. *Zeits. f. phys. Chem.* 139. *pp.* 143–150, *Dec.*, 1928.

The alkaline earth metals Ca, Sr and Ba are present in large quantities in the earth's crust, and have even atomic numbers. Uranium and thorium, which have also even atomic numbers, occur in quantities of the same order of magnitude as their next lower homologues, tungsten and hafnium, and this suggests the possibility of the existence of a stable isotope of radium, homologous with barium. An attempt was made on a large scale by numerous systematic recrystallisations of barium bromide to obtain an enriched material in which the existence of this hypothetical isotope could be recognised spectroscopically as its spectrum would be the same as that of radium, but without result. The amount, if any, per gramme of Ba is less than 2×10^{-10} gm. H. N. A.

1051. Optical Investigation of the Atomic Structure of Helium. J. Stark. *Ann. d. Physik*, 87. 7. *pp.* 927–934, *Dec.* 8, 1928.

In a recent work the author has called attention to the relation between the series of ortho-helium and the series of the components of the hydrogen lines in an electrical field. The investigations of Foster and of Ishida and Kamijima on the effect of an electrical field on the helium lines, and an earlier work by the author, make it possible to deal with the number and arrangement of the helium para series. These are compared, not directly with the H component series, but with the ortho-helium series, and it is shown that the lines of the para series $2P^2 - mP^2$ correspond exactly to those of the ortho series $2p^2 - mp^2$. Both appear with noticeable intensity in an electrical field, and with smaller field intensity the higher the serial number. The ortho lines, however, lie on the positive side of the null line, while the para line lie on the negative side; they are separated further and further from one another when the field intensity is increased. In the same way the lines of the para series $2P^2 - mD^3$ correspond to those of the ortho series $2p^2 - md^3$, and a number of other corresponding pairs of series are mentioned, which behave in the same way. The *se*-components of the lines $2s - mp^4$ and $2S - mP^4$ possibly form an exception to the rule. An explanation of this behaviour of the lines is given, which agrees with the structure assigned to the helium atom by the author in recent work.

H. N. A.

1052. Metastability of Elements and Compounds as a Consequence of Enantiotropy and Monotropy. Heat of Solution. E. Cohen and J. Kooy. *Zeits. f. phys. Chem.* 139. *pp.* 273–350, *Dec.*, 1928.

The general results of this comprehensive investigation are summarised as follows: Recent researches have shown that the accepted physico-chemical constants of solid substances are often very erroneous, due largely to physical impurities. The present paper contains a systematic investigation of the heats of solution at 20° of the stable chemically and physically pure modifications of five salts. Whilst previous thermal history appears to have had no influence on the behaviour of KCl and NaCl; an appreciable difference was noticed for K_2SO_4, KNO_3 and Tl_2SO_4. In general, the pure fused substance passes on rapid cooling into the form which is stable ultimately, so that its heat of solution deviates only slightly, or not at all, from the normal value. The presence of a trace of decomposition product in K_2SO_4, however, produces a very appreciable amount of the metastable modification in the cooled melt. If the salt is heated above the transformation—but below the fusion—temperature, the metastable content is considerably greater than after simple fusion and cooling. K_2SO_4 occurs in two modifications, and the heat of solution of the $\alpha - K_2SO_4$ to $K_2SO_4 . 400\ H_2O$ at 20° C. amounts to $- 6284 \pm 4$ g. cal.; KNO_3 exhibits enantiotropy, the data for the stable α-form to $KNO_3 . 200\ H_2O$ being $- 8336 \pm 2$ g. cal. and of the β-unstable form to $KNO_3 . 350$, $- 8426 \pm 2$ g. cal.; Tl_2SO_4 to $Tl_2SO_4 . 3200\ H_2O$ is $- 7940 \pm 60$ g. cal.; KCl to $KCl . 200\ H_2O$ at 20° C. is $- 4191 \pm 2$, and at 25° C. $- 4372 \pm 2$ g. cal.; NaCl to $NaCl . 100\ H_2O$ is $- 1100 \pm 4$ g. cal. at 20° and $- 965 \pm 2$ g. cal. at 25° C.

H. H. Ho.

1053. Assignment of Quantum Numbers for Electrons in Molecules. Part II. Correlation of Molecular and Atomic Electron States. R. S. Mulliken. *Phys. Rev.* 32. *pp.* 761–772, *Nov.*, 1928.

Makes a few revisions in Table III of Part I [see Abstract 63 (1929)] for N_2^+, CN and O_2^+, which are suggested by recent work of Herzberg on N_2^+; they involve dissociation of unexcited molecules giving one excited atom or ion. Discusses the heat of dissociation (D_x) of the lowest electronic state (X) of N_2; some of the evidence points to the value 11·8 volts, but on the whole it appears probable that the correct value is 9·5 volts. It now appears that with two possible exceptions (state *a* of N_2, if D_x is taken as 11·8, and one state of O_2^+) all the assignments are in conformity with Hund's rule that σ_l and *s* for the molecule should be obtained from the atomic σ_l and *s* values by addition; except for one or two states of F_2 the σ_{l_r} conservation rule also holds, no strict theoretical basis has been found for this rule. Gives an interpretation of the dissociation process which produce Hogness and Lunn's ionisation potentials of 21 and 22 volts for NO, and of 24 volts for N_2^+. Birge and Sponer's values of the heat of dissociation for several molecules, including N_2, are revised to N_2, 9·5; N_2^+, 7·1; NO, 7·3; CO^+, 8·3; NO^+, 11·2. The alkali and hydrogen halides are briefly discussed. H. N. A.

1054. Working Sectional Area of Neutral Gas Molecules for Slow Electrons. C. Ramsauer. *Phys. Zeits.* 29. *pp.* 823–830, *Nov.* 15, 1928. *Paper read before the Deut. Naturforscher u. Ärzte, Hamburg, Sept.*, 1928.

A review of the subject, illustrated by numerous diagrams reproduced from the original papers; work on the working sectional area for positive corpuscles is also noticed. Suggestions are made as to the directions in which further research is desirable. As many gases as possible should be investigated, and the curves should be considered in relation to the other physical and chemical properties; the investigations should be extended to the very important region between 1 volt and 0 volt, this has already been done for certain gases by Rusch; the total effect should be analysed into its component parts, though the idea of a sum of partial section areas is a rather rough one, and it should be remembered that in reality it is a question of probability; Zachmann and Kollath have done work in this direction. So far theory has not helped very much in the development of the subject, the author considers that the work of Faxén and Holtsmark, who make use of wave mechanics, seems to be the most promising so far. H. N. A.

1055. Working Sectional Area and Molecular Structure in the Pseudo Rare Gas Series Ne, HF, H_2O, NH_3, CH_4. E. Brüche. *Phys. Zeits.* 29. *pp.* 830–834, *Nov.* 15, 1928. *Paper read before the Deut. Naturforscher u. Ärzte, Hamburg, Sept.*, 1928.

The curves for CH_4 and Ne had already been obtained. The author has made measurements for two of the other five gases of the series, H_2O and NH_3, and constructed the curves for them. There are considerable differences in the shapes of the four curves, particularly in the portions corresponding to low velocity electrons; all four gases are supposed to have the same number of electrons—eight, in the outer shell—and the author concludes that this fact is not sufficient to fix the type of curve. Grimm's law of shift in the hydrides seems to hold fairly well for electrons with velocities from $3\sqrt{\text{volts}}$ to $7\sqrt{\text{volts}}$, but not at all for lower velocities, the CH_4 curve is the only one that continues to drop like that of N*e* when the velocity diminishes. The similarity between the curves of CH_4 and K*r* is discussed, it is suggested that the structure of the outer shell of electrons must be very similar in these two gases. H. N. A.

1056. Contribution of Reflection to the Total Action of Neutral Gas Molecules on Slow Electrons. R. Kollath. *Phys. Zeits.* 29.

pp. 834–836, *Nov.* 15, 1928. *Paper read before the Deut. Naturforscher u Ärzte, Hamburg, Sept.*, 1928.

An attempt to begin the separation of the total action into its component parts, dealing with reflection, loss of electron velocity and absorption. Reflection without loss of velocity was first dealt with, measurements being made at an angle of 90° with the electron beam, with different gases. It appears from the curves obtained as if for all the gases the first rise of the working sectional area curve, starting from one volt electron velocity, is due essentially to reflections without loss of velocity. For larger velocities the different groups of gases behave differently. In the Ar group the maximum cannot be explained by reflection without change of velocity; in the H_2 group the reverse is the case; in N_2, CO, CO_2 and N_2O the first sharp maximum can be explained as due to reflection without change of velocity, the second maximum at higher electron velocity must be due to some other cause. Reflection with change of velocity, including absorption, was also investigated; the second maximum of the working sectional area curves was shown not to be due to this cause. H. N. A.

1057. Nuclear Motions Associated with Electron Transitions in Diatomic Molecules. E. U. Condon. *Phys. Rev.* 32. *pp.* 858–872, *Dec.*, 1928.

The question of nuclear motions associated with electron transitions is discussed from the standpoint of quantum mechanics. It appears that Heisenberg's indetermination principle gives the clue to the inexactness of the earlier method based on Franck's postulate, since its strict application calls for a violation of the principle. The existence of an entirely new type of band spectrum due to the wave nature of matter is predicted, and the interpretation of Rayleigh's mercury band at 2476–2482 Å.U. as of this type is suggested. Finally, it is shown that while Franck's postulate is also true for electron jumps in atoms, it is of but trivial interest, because its inexactness is much greater for the electrons than for heavy nuclei.

AUTHOR.

1058. Quantum Theory of Molecule Formation. H. Lessheim. *Zeits. f. Phys.* 51. 11–12. *pp.* 828–841, 1928.

The form of the symmetry character of the "centre of gravity" function, on which London's theory of non-polar combination depends [see Abstract 842 (1928)], is shown to correspond to one of three possible solutions, the other two being excluded from the start by not taking into account reciprocal action between the c. of g. motion and spin. One of the latter solutions is found to give a more satisfactory representation of the chemical facts, in particular of the special character of the rare gases distinguishing them from the neighbouring elements in the periodic classification. W. S. S.

1059. Vector Relations of the Atom in Quantum Mechanics. E. Fues. *Zeits. f. Physik*, 51. 11–12. *pp.* 817–827, 1928.

The author discusses mathematically the significance in the new quantum mechanics of the addition laws for impulse moment vectors, used in the earlier quantum theory in explanations of the Zeeman effect, multiplet regularities, etc. The analysis is based on group theory, and a correspondence is established between the vectors of the older theory and the group character of rotation groups in three-dimensional space. W. S. S.

1060. Undulatory Mechanics of Alkali-Metal Atom in Electric Field. *Parts I and II.* **E. Rasetti.** *Accad. Lincei, Atti,* 7. *pp.* 839–844, *May* 20, 1928; *and pp.* 1010–1014, *June* 17, 1928.

Part I shows how to calculate the perturbations due to an electric field acting on an alkali-metal atom, to a second approximation. Part II applies the theory to particular cases, numerically determining the energy variations of the atom, the Stark effect and the dielectric constant. A. D.

1061. Optical Resonance in Undulatory Mechanics. E. Persico. *Accad. Lincei Atti.* 8. *pp.* 55–59, *July*, 1928.

In a fundamental memoir on undulatory mechanics [see Abstract 55 (1927)] Schrödinger showed how his model enabled the phenomena of optical resonance, observed by Wood and others, to be qualitatively predicted. But he renounced quantitative calculations, noting that the phenomenon must be influenced by the radiation-reaction, with which undulatory mechanics was at the time not able to deal. But since then Fermi, in endeavouring to elucidate the mechanism of the emission of spectral lines, has [see Abstract 3050 (1927)] put forward an approximate method of taking this force into account in undulatory mechanics, and it is now possible completely to develop the theory of optical resonance from the point of view of Schrödinger's mechanics. This is the object of the present paper. Further papers are promised. A. D.

1062. Principle of Least Action in Wave Mechanics. J. M. Whittaker. *Roy. Soc., Proc.* 121. *pp.* 543–557, *Dec.* 3, 1928.

The object of the paper is to obtain a set of equations which shall include the electromagnetic and gravitational equations, but which differ from these in having "wave" terms in place of the "particle" terms of the Maxwell and Einstein equations. The wave equations used are those already derived by the author [see Abstract 423 (1929)]. It is found possible to derive a consistent scheme covering quantum, electromagnetic and gravitational actions. W. S. S.

1063. Physical Interpretation of Wave Mechanics. G. Temple. *Phys. Soc., Proc.* 41. *pp.* 60–82; *Disc.*, 82, *Dec.*, 1928.

The object of this paper is to give an account of the fundamental principles of wave mechanics in a manner which shall make clear the physical significance of all the quantities and processes involved. The principles are illustrated by discussions of the propagation of free electric waves in uniform electromagnetic fields and of bound electric waves in the hydrogen atom. The paper concludes with relativistic wave mechanics (prior to the work of Dirac and Darwin) and a short account of the Compton effect. AUTHOR.

1064. Symmetrical Treatment of the Wave Equation. A. S. Eddington. *Roy. Soc., Proc.* 121. *pp.* 524–542, *Dec.* 3, 1928.

This mathematical paper deals with the theory of a certain type of matrices introduced by Dirac in deriving his wave equations for the electron [see Abstracts 1168 and 1507 (1928)]. The matrix theory leads to a simple derivation of the first order wave equation, equivalent to Dirac's, but expressed in symmetrical form. A wave equation is also obtained, which can be identified as the form appropriate to a system containing electrons with opposite spin. The symmetrical method is also shown to be advantageous in deducing general properties, such as the angular momentum of an electron and the conservation of the supposed charge-current vector. W. S. S.

1065. Inverse Processes to Spontaneous Radiationless Quantum Transitions (Radiationless Combination in Two-Body Collisions). A. Smekal. *Ann. d. Physik*, 87. 7. *pp*. 959–964, *Dec*. 8, 1928.

Previous arguments against the existence of radiationless combination of electrons and atoms in two-body collisions have rested on the impossibility of satisfying both conservation of energy and conservation of momentum in such processes. The same reasoning, however, would exclude the absorption of light quants (in a finite amount), and it is concluded that a finite wave-mechanical probability must also exist for radiationless two-body combination. By an argument similar to Einstein's for the case of the emission and absorption of radiation in a system in temperature equilibrium, it is further shown that a radiationless induced emission of electrons must occur, and that in fact Einstein's three elementary radiation processes have their analogues in radiationless corpuscular processes. W. S. S.

1066. Spontaneous Emission of Radiation. L. Goldstein. *Comptes Rendus*, 187. *pp*. 1285–1286, *Dec*. 28, 1928.

§ 1 discusses the apparent incompatibility between the two fundamental ideas of the stationary state in the Bohr-Sommerfeld sense and the spontaneous change of atomic configuration. § 2 considers the same difficulty in the undulatory mechanics, either according to the Broglie-Schrödinger viewpoint, or the more abstract notions of Dirac. It is concluded that to give a physical explanation for the occurrence of spontaneous emission is impossible with atomic structures as envisaged at present. H. H. Ho.

1067. Quantum Theory. H. S. Allen. *Nature*, 122. *pp*. 887–894, *Dec*. 8, 1928. *Supplement*.

In this reprint of a lecture the present position of the quantum theory is outlined. After discussing briefly matrix mechanics, wave mechanics, and Dirac's quantum numbers, the lecturer concludes with comments on Bohr's latest suggestion that the failure of the causal space-time description of phenomena for atomic processes is due to the smallness of the quantum of action compared with the actions involved in ordinary sense perceptions. W. S. S.

1068. Hamiltonian Function for Conservative Systems. B. Podolsky. *Phys. Rev*. 32. *pp*. 812–815, *Nov*., 1928.

Dirac has shown [see Abstract 1292 (1927)] that, if in the Hamiltonian function H momenta η_r, conjugate to the coordinates ξ_r, are replaced by $(h/2\pi i)\partial/\partial\xi_r$, the Schrödinger equation appropriate to the coordinate system ξ_r is $(\mathrm{H} - \mathrm{E})\psi_\xi = 0$. When applied to coordinate systems other than Cartesian this usually leads to incorrect results. The difficulty is here traced partly to the way in which ψ_ξ is normalised and partly to the choice of H. In H expressions such as $qpq^{-1}p$ and p^2 are not equivalent, and the simplified form is generally incorrect. A formula, satisfying all the requirements of quantum mechanics, is developed for a Hamiltonian function of a conservative system, in an arbitrary coordinate system. Applied to a case of plane polar coordinates the formula is shown to give correct results. A. W.

1069. Error Tensors and the Error Distribution Law of Elementary Vectorial Algebraic Operations. A. Basch. *Akad. Wiss. Wien., Ber.* 137. *2a. No.* 8. *pp.* 583–598, 1928.

A theory of errors associated with vectors in space of any arbitrary number of dimensions is developed. More especially it is shown that error distribution is associated with an error tensor which can be geometrically represented by means of an error hyperboloid. The mean errors of the scalar products of two vectors and of triple products in three-dimensional space are discussed. J. S. G. T.

1070. Electromagnetism and the Fifth World-Dimension. E. Reichenbächer. *Phys. Zeits.* 29. *pp.* 908–911, *Dec.* 1, 1928. *Paper read before the Deut. Naturforscher u. Ärzte, Hamburg. Sept.*, 1928.

Difficulties in Weyl's theory and their resolution by means of a five-dimensional metric, as developed by the author, Kaluza and Klein are briefly referred to. J. S. G. T.

1071. Formal Extension of the Theory of Relativity and its Correlation with Electrical Theory. L. Infeld. *Phys. Zeits.* 29. *pp.* 810–811, *Nov.* 15, 1928.

Discussing the work of Hattopi [see Abstract 1180 (1928)], the author concludes that the theory of relativity cannot be generalised in a formal manner so as to include the gravitational and electrical fields. The world-geometry characterising a unified theory of the two fields is to be investigated, having regard to its physics. J. S. G. T.

1072. New Metric of Einstein and the Wave Equation. H. T. Flint. *Roy. Soc., Proc.* 121. *pp.* 676–681, *Dec.* 3, 1928.

Inherent difficulties of the four-fold metric developed in previous work [see Abstracts 1182 and 1183 (1928)] are removed by substituting the new metric of Einstein, in which a definition of parallelism at separate points is added to the Riemannian geometrical scheme. The wave equation then takes a very simple form. The physical interpretation of a fundamental vector occurring in the system is deduced from the equation, and the metrical character of the wave function and its equation is discussed. J. S. G. T.

1073. Rigorous Solution of Einstein's Field Equations for any Static Gravitational Field Possessing Spherical Symmetry. H. Bauer. *Phys. Zeits.* 29. *pp.* 954–963, *Dec.* 15, 1928.

A rigorous general solution of Einstein's field equations

$$R_{iK} = x(T_{iK} - g_{iK}T/2)$$

is derived by integration. The fundamental tensor, *ds*, is derived in the form

$$ds^2 = g_{iK}dx^i dx^K = g_0 dt^2 - g_1 dr^2 - r^2(d\theta^2 + \sin^2\theta d\phi^2),$$

where $g_0 = [c^2 e^{\int(1-xr^2T_1)dr/(r-a-x\int r^2T_0 dr)}]/r,$

and $1/g_1 = 1 - a/r - (x\int r^2 T_0 dr)/r,$

T denoting the energy-impulse tensor. Special cases, including the field of an electron, an incompressible and compressible fluids, and the case of constant density and pressure are discussed. Cosmological forms of the field equations are similarly solved and discussed, and the same special cases considered. The solution of the field equations having reference to Einstein's cylindrical universe is briefly discussed. J. S. G. T.

METEOROLOGY AND GEOPHYSICS.

1074. Rate of Decay of Atmospheric Eddies. L. D. Vaughan.

Monthly Weather Rev. 56. *pp.* 264–274, *July*, 1928.

The author describes a series of tests made to investigate the dynamical nature of eddies, their growth and rate of decay. Observations were made when the air was very clear and quiet on eddies formed in the rear of railway trains, motor-cars and other vehicles travelling on or near the ground. The air was found to move in the form of a long helix, whose diameter was almost independent of the train speed. A relation was established between the size and shape of the body and of the eddies created in the fluid at the instant of maximum development. The mathematical theory is examined in detail and the production of turbulence in the atmosphere. R. S. R.

1075. Integration of Atmospheric Disturbance Equations. Part I. Wave Motion in Rotating Incompressible Fluid Layers. H. Solberg.

Geofysiske Publ. Oslo, 5. *No.* 9. *pp.* 1–120, 1928. *In German.*

The author throughout deals with gravitational waves. In the first section he considers the equations for atmospheric disturbance, dealing first with a stratified liquid system, its movement and equations of flow and the equations resulting when a disturbance is introduced. The integration of the disturbance equations for two horizontal layers is obtained and wave motion considered with real, double and complex roots. The equations are next obtained for vertically limited surfaces and for inclined parallel layers. In the latter case wave motion in (1) an infinite, (2) a limited and (3) two limited layers with free surfaces are taken. Finally, wedge-shaped layers on a horizontal layer are investigated. The paper is almost entirely mathematical. R. S. R.

1076. Twenty-Eight-Month Periods in Solar Activities and Corresponding Periods in Magnetic and Meteorological Data. H. W. Clough.

Monthly Weather Rev. 56. *pp.* 251–264, *July*, 1928.

In the paper the author determines by methods, largely empirical, the definitive epochs of maxima and minima for the eleven-year and twenty-eight-month periods of various solar and magnetic phenomena. The average length and systematic variations in the length are found. The mean heliographic latitude of the entire spotted area of the sun shows a well-marked eleven-year variation with a maximum excess of spots in the northern hemisphere 3–4 years before the epoch of sunspot maximum, and in the southern hemisphere about a year before sunspot minimum. Elimination of the eleven-year variation discloses short period variations of irregular length, 2–4 years being most frequent. Epochs of maxima and minima from 1855 to 1925 show an average period of 2·55 years with a most frequent interval of 2·50 years. The interval is nearly two years at sunspot maxima and three years at sunspot minima. New determinations of the eleven-year epochs of maximum and minimum magnetic declination range are given, and also a twenty-eight-month variation in the range. An eleven-year variation occurs in the twenty-eight-month period in terrestial temperatures with long and short intervals about four years after the Wolfer epochs of minima and maxima respectively. The short-period variations in temperature have a closer causal relation to the solar latitude than to the relative number variations, while epochs of maximum and minimum temperatures occur about one year later than the epochs of maximum southern and northern heliographic latitude respectively, and about four months before the epochs of minimum and maximum spottedness. [See Abstract 803 (1925).] R. S. R.

1077. Simple Formulæ for Computing Relative Humidity from Readings of the Dry and Wet Bulb Thermometers. R. M. Poulter. *Roy. Meteorolog. Soc., J.* 54. *pp.* 287–291; *Disc.*, 291, *Oct.*, 1928.

Two formulæ are given for computation of the relative humidity (H) in terms of the difference (*d*) between the temperatures of the dry bulb (T) and wet bulb (*t*). For temperatures 30°–90° F. and H 60–100 % he gives $H = 100 - 350d/T$. For a wider range of values he gives $H = 100 - 1000d/T$. The former holds very generally for the British Isles in winter, and the latter in summer. The differences between the values computed in this way and those found from British Tables do not exceed 1–2 %, and are comparable with those due to errors of 0·1–0·2° F. in reading the thermometers. R. S. R.

1078. Development of Meteorological Services for Civil Aviation. F. Entwistle. *Roy. Meteorolog. Soc., J.* 54. *pp.* 293–298, *Oct.*, 1928.

Meteorology is of importance to aviation (1) in planning air lines and individual flights on new routes, since the best route and most suitable aerodrome sites can be selected and the frequency of conditions likely to interrupt the air services determined; and (2) in supplying meteorological reports and forecasts for the operation of an air service. The author reviews the general scheme of regular and occasional meteorological reports made on the air routes from Croydon to Paris, Brussels and Amsterdam, and their dissemination by wireless telegraphy and to aircraft by radiotelephony. The evolution of an international system of weather reports for aviation is also mentioned. R. S. R.

1079. Effect of Ocean Currents on the Climate of Continents. A. J. Henry. *Washington Acad. Sci. J.* 18. *pp.* 556–558, *Dec.* 4, 1928. *Paper read before the Am. Geophys. Union.*

The author shows that the ocean currents play the part of a great regulator in the climatic changes independent of the movement of oceanic water. As shown by the Gulf Stream in the North Atlantic and the Japan current in the Pacific, a current moving from low to high latitudes increases the rainfall on the coast and neighbouring hills, but its effect decreases as the distance from the coast increases. The Humboldt or Peruvian current moving from a high to a low latitude along the west coast of South America lowers the temperature along the neighbouring coast, and greatly decreases the rainfall. The absence of the Gulf Stream in the North Atlantic would probably weaken the cyclonic circulation in those regions. R. S. R.

1080. Historical Climatology of England and Wales. C. E. P. Brooks. *Roy. Meteorolog. Soc., J.* 54. *pp.* 309–317, *Oct.*, 1928.

The author deals with the last 10,000 years when the flora and fauna of the British Isles received the impress of their present constitution. He summarises the main features of four periods: (1) 7500–5500 B.C., boreal period, cool, dry climate and epipalæolithic culture; (2) 5500–2500 B.C., Atlantic period, warm moist climate and neolithic culture; (3) 2500–850 B.C., sub-boreal period, warm, dry climate and neolithic bronze culture; and (4) 850–0 B.C., sub-Atlantic period, cold, wet climate, and iron age culture. The main features of temperature and rainfall for the subsequent period are discussed, and possible pressure distributions which could have caused these changes. R. S. R.

1081. Reliability of Different Methods of Taking Sea-Surface Temperatures. C. F. Brooks. *Washington Acad. Sci. J.* 33. *pp.* 525–545, *Dec.* 4, 1928. *Paper read before the Am. Geophys. Union.*

The author discusses observations of sea-surface temperature obtained during a voyage between San Francisco and New York, and their bearing on conclusions formed earlier [see Abstract 74 (1927)]. He explains the advantages and disadvantages of obtaining temperatures with an intake thermograph. The sources of errors in the bucket method are detailed and means for decreasing the errors. It is concluded that, except in calm or nearly calm weather, temperatures at depths of 5 to 7 metres are the same as, or within 0°·2 C. of, those at the surface in forty-nine cases out of fifty. In quiet weather the differences exceed 1°·5 C., while near the shore the differences are greater than at sea. R. S. R.

1082. Significance of Water-Temperature Measurements Not Made Exactly at the Surface. G. F. McEwen. *Washington Acad. Sci., J.* 32. *pp.* 545–546, *Dec.* 4, 1928. *Paper read before the Am. Geophys. Union.*

Hourly observations were made of condenser intake temperatures by each of thirty ships over a period of ten days south-west of San Diego, California. Two groups were made for (1) calibrated thermometers and thus corrected readings, and (2) uncalibrated thermometer. The average temperature for each of 141 squares of 30′ side was found, and a difference of about 0°·1 C. was found between the two groups. To get temperatures over such an area to 0°·2 C., sixteen observations are required. The surface temperature exceeds that at a depth of 5 metres least in mid-winter and most in mid-summer, while the difference decreases with increase of latitude, and becomes zero for wind speeds 15 m.p.h. R. S. R.

1083. Time Required for Temperature Departures to Cross from the Western to the Eastern Side of the Pacific, and Changes in Departures during the Crossing. G. F. McEwen. *Washington Acad. Sci., J.* 32. *pp.* 546–548, *Dec.* 4, 1928. *Paper read before the Am. Geophys. Union.*

The author summarises three methods by which surface drift across the Pacific can be computed from temperature observations and their departures from mean values over 5° squares. Care is required in selecting the appropriate intervals of time and space in order to reduce the effect of accidental variation. R. S. R.

1084. Effect of Surface Winds upon Ocean Drift. G. W. Littlehales. *Washington Acad. Sci., J.* 32. *pp.* 548–550, *Dec.* 4, 1928. *Paper read before the Am. Geophys. Union.*

After a discussion of the general effect of surface winds on the currents in the open sea, an expression is found for the depth of the drift current, *i.e.*, that depth at which the current has completed its first half revolution. The direction and velocity of the current at this, or any other depth, are then found. The general connection between wind circulation and ocean currents is also explained. R. S. R.

1085. Geophysical Prospecting. A. Rostagni. *Accad. Lincei, Atti,* 7. *pp.* 1006–1010, *June* 17, 1928.

Application, to tracing out conductive materials in the subsoil, of a theorem of T. Levi-Civita on the influence of a conductive screen on the electro-magnetic field of an alternating current parallel to the screen. A. D.

1086. Transverse Seismic Waves on the Surface of a Semi-Infinite Solid Composed of Heterogeneous Material. H. Bateman. *Am. Math. Soc., Bull. pp.* 343–348, *May–June,* 1928. *Reprint.*

The author obtains mathematically a solution involving functions only of an elementary nature. It differs from that obtained by Meissner for a heterogeneous medium in which the density and rigidity vary continuously and monotonically, and the author expresses a doubt regarding the validity of the approximation and differentiation employed. R. S. R.

1087. Interpretation of Superficial Seismic Waves. E. Oddone. *Accad. Lincei, Atti,* 8. *pp.* 64–70, *July,* 1928.

Discordances in present theories pointed out and discussed. Shows how recent conceptions (Mohorovicic's surface of discontinuity, revised values for the velocity of longitudinal waves, etc.) simplify matters. A. D.

ASTROPHYSICS.

1088. Spectrum of the Solar Corona. I. M. Freeman. *Astrophys. J.,* 68. *pp.* 177–193, *Oct.,* 1928.

It has been found possible to associate over half of the "unknown" emission lines of the corona with known lines in the spectrum of argon from the data compiled by Campbell and Moore. Ten more coronal wave-numbers were given by intercombinations of Meissner's term values for argon. A systematic examination of the spectra of prominent solar elements gave no significant correlations beyond a few chance numerical agreements. The means of excitation of the coronal lines is discussed, and the bearing of the present identification on modern theories of the physical nature of the corona is indicated. AUTHOR.

1089. Evidence of Boron in the Sun. S. B. Nicholson and N. Perrakis. *Mt. Wilson Observat. Contrib. No.* 370. *Astrophys. J.* 68. *pp.* 327–334, *Nov.,* 1928.

[See Abstract 2627 (1928).]

1090. Radial Limitation of the Sun's Magnetic Field. S. Chapman. *Roy. Astron. Soc., M.N.* 89. *pp.* 57–79, *Nov.,* 1928.

It is shown mathematically that the gravitational, electrostatic and magnetic fields in the sun's reversing layer cause an eastward "drift-current" of electrons of the right order of magnitude to explain the radial limitation of the sun's magnetic field. A lower limit, of the same order as that found by Milne, is set to the pressure at the base of the reversing layer. The observed rapid downward increase of intensity of the sun's magnetic field probably continues to a depth of about 100 km. below the photosphere, where the intensity rises to 10,000 gauss. The drift-currents in the upper layer confine within the atmosphere tubes of magnetic force of internal origin. The internal field is produced by a system of westward electric currents in a deeper layer. This system is attributed to electromagnetic induction by internal circulation of solar matter in meridian planes; the orders of magnitude involved in the theory are not unreasonable, if the circulation is similar to that postulated by Bjerknes in his theory of the sunspot cycle. J. S. G. T.

1091. Sun's General Magnetic Field and the Chromosphere. S. Chapman. *Roy. Astron. Soc., M.N.* 89. *pp.* 80–84, *Nov.*, 1928.

In connection with the theory developed in a previous paper [see preceding Abstract), it is shown that in the upper reversing layer and chromosphere selective radiation-pressure is important. It is shown that the strong eastward motion in the chromosphere indicates that the sun's general magnetic field cannot extend appreciably into the chromosphere. J. S. G. T.

1092. Magnetic Storms and Solar Activity, 1874 to 1927. W. M. H. Greaves and H. W. Newton. *Roy. Astron. Soc., M.N.* 89. *pp.* 84–92, *Nov.*, 1928.

In a previous paper [see Abstract 2306 (1928)] the Greenwich solar and magnetic observations of 1874 to 1927 were compared, and it was established that "great" storms were associated with large spots near the central meridian of the sun more often than can be ascribed to chance. In this paper the discussion is extended to include the smaller storms of the period, numbering 343. The results confirm and extend the conclusion regarding a general association of storms with spots: they follow the 11-year cycle, and large storms tend to be connected with large spots; yet storms do occur without spots, and no significant difference in spot activity has been found between the smallest storms and magnetically quiet days. Storms appear to have their origin not in spots, but in some solar disturbance situated in the central portion of the disc, in the chromosphere, and there is a tendency for these solar disturbances to give rise also to large spots. The theory is confirmed which was first advanced by Maunder, that storms are caused by some agency proceeding from a restricted area of the sun's surface and arriving on the earth in a definite interval of time. Lindemann has suggested that the agency is ionized gas ejected from the sun by radiation-pressure. Since it has been remarked that metallic prominences follow the spot-cycle and are often associated with spots, a comparison of these with magnetic storms might be useful. There is some evidence that storms with "sudden commencements"—that is, those commencing almost simultaneously all over the earth—are especially closely associated with spots. M. A. E.

1093. Aurora Borealis. I. Ranzi. *N. Cimento*, 5. *pp.* 145–152, *Aug.-Sept.-Oct.*, 1928.

An interesting synopsis of recent observations and theories on the Aurora Borealis. A. D.

1094. Ultra-Violet Light of Sun as Origin of Auroræ and Magnetic Storms. H. B. Maris and E. O. Hulburt. *Nature*, 122. *pp*. 807–808, *Nov.*, 1928.

A theoretical investigation has been made of the outlying regions of the atmosphere of the earth and of the effect of sunlight on these regions: certain of the conclusions are given in this preliminary note. It is shown that high up in the earth's atmosphere there must be a number of high-flying atoms which are ionised during daytime by the short-wave ultra-violet light of the sun, and that some of these, reaching the polar regions after sundown, hand over their energy of recombination to the atmosphere of those regions, where it may reappear as auroral display. Quantitative estimates are given, and the main characteristics of the aurora receive logical explanation on this theory. These high-flying ions also give rise, when the sun is active, to magnetic storms. They descend in large numbers to the zones about 25° from the magnetic poles, and form there diamagnetic concentrations of considerable intensity. Upon working out the changes in the Earth's magnetic field caused by this diamagnetism, agreement is found in practically every detail with the observed complicated diurnal storm variations in the three magnetic field components at all latitudes.

M. A. E.

1095. Origin of the Aurora Polaris. S. Chapman. *Phys. Rev.* 32. *pp*. 993–996, *Dec.*, 1928.

Hulbert's new theory of the aurora [see Abstract 2631 (1928)] is criticised, principally because ions and electrons produced by ultra-violet radiation from the sun cannot travel far polewards from low and middle latitudes of the earth's atmosphere, but must often descend into lower levels and be checked by collisions. Several characteristic features of auroræ are also better explained by the theory of charged particles emitted from the sun.

In his reply to the above (*ibid.*, p. 996) **E. O. Hulburt** states that in his paper on the physics of the outer fringe of the earth's atmosphere, to be published shortly, it will be shown that the ion spray caused by the ultra-violet light of the sun may reach heights of about 30,000 km. above the equator, and may distil to within 20° or 30° from the magnetic poles, *i.e.*, to the zone of maximum auroral frequency. The prominent characteristics of the aurora can be logically explained on this theory. M. A. E.

1096. Part played by Atmospheres of Planets in Stellar Occultations. C. Fabry. *Comptes Rendus*, 187. *pp*. 627–631, *Oct.* 15, 1928.

If a star is occulted by a planet with an appreciable atmosphere, its light experiences both deviation and enfeeblement before it disappears. The most important cause of enfeeblement is not absorption, but the divergence of the light rays at different heights of the atmosphere. The author finds that this enfeeblement (Φ) is a function of: (1) Deviation, $\omega = A\Phi$; (2) true angular distance, $\theta = \text{const.} - A(\Phi + \log \Phi)$; (3) apparent angular distance, $\alpha = \text{const.} - A \log \Phi$; (4) pressure of the lowest layer traversed, $p = \omega_1 \Phi$; (5) reduced thickness of the gas traversed, $x = c\Phi$. $A = h/D$, and is an extremely small numerical constant which can be transformed into an angle and is never more than a small fraction of a second; $c = h^2/(\epsilon_1 D)$, and is a very small quantity;

$$\omega_1 = h/D \times \sqrt{h/2\pi R} \times p_1/\epsilon_1,$$

and is a very small pressure. If it should be found possible to observe the law of change of magnitude immediately preceding occultation, the comparison of its curve with the theoretical one would give the constant A, and the quantity h, and the latter would give the specific gravity (μ_1) of the gas when reduced to normal pressure without change in its temperature. The deviation to be observed is in all cases very small.

A. S. D. M.

1097. Diffraction Property of a Circular Diaphragm. M. Hamy. *Comptes Rendus*, 187. *pp*. 624–626, *Oct*. 15, 1928.

If D is the linear diameter of a circular diaphragm placed before an objective, ϵ the angular semi-diameter of the star, λ the wave-length of light admitted to the observer's eye after passing through a monochromatic filter, the author finds that near the geometrical border the expression for the intensity is a unique function of the variable $x = 2\pi D\zeta/\lambda$, where ζ is the angular distance from this border of the point of the image considered. In the focal plane near the geometrical border the intensity can be expressed by $I = AD^2f(x)$. A being a constant depending on the wave-length λ, on ϵ, and on the unit of intensity adopted, this expression may be simplified to $I = D^2y$, where $y = 1$ when $x = 0$. The author concludes that as D varies, and the eye-piece is constantly chosen so as to furnish to the telescope an enlargement proportional to D, there corresponds to each point x, y, of the intensity curve, a point on the virtual field given by the eye-piece, which remains at a constant angular distance from the geometrical border, and whose intensity (proportional to y) remains invariable as D varies.

A. S. D. M.

1098. Physics of the Universe. J. Jeans. *Nature*, 122. *pp*. 689–700, *Nov*. 3, 1928. *Supplement. Henry Herbert Wills Memorial Lecture of the University of Bristol.*

Discusses the ages of the stars, as deduced from the fact that there appears to be a marked approximation to equality of energy of motion in the individual stars and in binaries. The general age of the stars is probably between five and ten million million years, and that of the sun may be between seven and eight million million years. It is shown that a mass of pure thorium equal to that of the sun would be reduced to a single atom within three million million years, while for uranium the corresponding time is less than a million million years. There is no possibility of either of these substances being formed from lighter elements at stellar temperatures, and the lecturer concludes that they must have been formed in the sun by radioactive disintegration of unknown heavier elements, for the method of original production of which no theory can be suggested. Considers the universe as a heat engine; the old thermodynamics breaks down, since neither total energy nor total mass can be regarded as constant; competing schemes of revised thermodynamics lead to different results; however, when the "emptiness" of space is considered they practically coincide; the final state of maximum entropy results when every atom which is capable of doing so has dissolved away into radiation, there is no creation of matter out of radiation in any part of the known universe. One way of treating the origin of the universe is by regarding space, time and matter as forming inseparably a single system, so that it is meaningless to speak of space and time as existing at all before matter existed; this is in agreement with ancient metaphysical theories, and with the theory of relativity. Millikan's cyclic universe clashes with the second law of thermodynamics. H. N. A.

1099. Two A-Type Binaries and Radial Velocities of 50 Stars. R. M. Petrie. *Dominion Astrophys. Obs., Victoria, Publ.* 4. 7. *pp.* 81–95, *Jan.*, 1928.

H.R. 6611.—The orbit of this double-lined star is based upon 26 plates, these being equivalent to 47 observations. The masses are nearly equal, 1·8 and 1·6 times the sun, eccentricity low, 0·04, and period 3·894 days.

H.R. 6979.—The determination of the orbit of this star rests upon 28 spectrograms, of which 26 show the spectra of both components. The period is 14·345 days, the eccentricity is 0·21, the amplitudes 68·29 and 72·01 km., and the masses of each nearly twice that of the sun.

Radial Velocities of 50 stars.—The radial velocities determined from 206 plates of 50 stars, of which about 20 are binaries, are tabulated. AUTHOR.

1100. Spectroscopic Orbit of H.D. 176819 and H.D. 185936. P. M. Millman. *Dominion Astrophys. Obs., Victoria, Publ.* 4. 8. *pp.* 97–101, *Jan.*, 1928.

The spectroscopic binary H.D. 176819 was investigated from 19 plates. Its period is about 16 days. Elements were corrected by least squares solution, using individual observations.

H.D. 185936 was investigated for orbit. Sixty-six spectrograms taken at the observatory give discordant results; no solution possible. Velocity of system = − 4·93 km. AUTHOR.

1101. Spectrum of Nova Cygni 3 in August and September 1920. A. Jenvall. *Astron. Iakttagelser. Undersökning., Stockholm,* 11. *No.* 4. *pp.* 3–15, 1928. *In French.*

1102. Two Spectroscopic Orbits and Upsilon Sagittarii. J. S. Plaskett. *Dominion Astrophys. Obs., Victoria, Publ.* 4. 9. *pp.* 103–118, *Feb.*, 1928.

H. D. 193536, a double-lined binary of type B, has a period of nearly three days, and the masses are 2·90 and 2·35 times the sun. The orbit of 56°2617 has been rediscussed, and it is found that a period of 3·7103 fits the observations. The relative intensity distribution in the peculiar complex spectrum of υ Sagittarii has been determined by making exposures for the same time upon this star and four others of different types. The spectrum corresponds most closely with that of the Fo star, and the metallic—not the helium—is its fundamental spectrum. Three hundred absorption lines in its spectrum are here tabulated, with the intensity and when possible the source of each. M. A. E.

1103. Variable Star S Sagittæ. G. Tiercy. *Arch. des Sciences,* 10. *pp.* 285–308, *Sept.-Oct.*, 1928.

An investigation based on 13 "Capelli-blue" plates taken in 1924 and 18 taken in 1927. Tables and curves for q (dependent on magnitude) and light are given as for T Vulpeculæ [see Abstract 2647 (1928)] and for X Sagittarii [see Abstract 2967 (1928)]; the radius at maximum light of S Sagittae is 27 times that of the sun; its pressure is about 0·0022 atm.; and its temperature (for type F4) about 7000°. Its colour index (I) is derived from $0{\cdot}819\ \mathrm{I} = \log \mathrm{R} + 0{\cdot}2\ \mathrm{M}\nu - 0{\cdot}515$, but this is amended to $0{\cdot}819\ \mathrm{I} = \log \mathrm{R} + 0{\cdot}2\ \mathrm{M}\nu + \Phi$, where Φ is a function of the spectral type and geometrical size of the star, and is given a special value for each type and each radius, a distinction being made between giants and dwarfs. The variable function Φ is derived from the study of T Vulpeculæ, X Sagittarii, S Sagittæ and W Sagittarii (unpublished). A. S. D. M.

1104. Spectrographic Triple System 28 η Orionis A′A″ − D. A. Pogo. *Astrophys. J.* 68. *pp.* 309–318, *Nov.*, 1928.

An increase of more than 20 km./sec. in the velocity of the centre of mass of the spectroscopic binary A′A″, between the epochs 1925–8 and 1927–9, was derived from 31 spectrograms secured at the Mount Wilson (4 plates), Dearborn (10 plates), and Yerkes (17 plates) observatories. The new γ-values, combined with those published since 1902, lead to the following preliminary orbital elements of the oscillation of long period: velocity of the triple system A′A″ − D, + 19·5 km./sec.; period, 9·2 years; epoch of periastron passage, 1900·0; longitude of periastron of A, 270°; eccentricity, 0·1; half-amplitude of oscillations of A, 17·5 km./sec.; major semi-axis of the inclined absolute orbit of A, 800 million km.; function of mass of satellite D, 1·84 $\odot$. Assuming a small relative inclination of the long-period orbit and of the orbit of the eclipsing binary A′A″, the mass of the third body D is found to be 13·1 $\odot$, of the same order as the masses 11·2 of A′ and 10·6 of A″; the total, about 35 $\odot$, is normal for a system of early B-type stars. The mean distance between the spectroscopic binary A′A″ and the third star D is about 14·3 astronomical units. With the Mount Wilson spectrosopic parallax of 0·007″, the maximum angular separation of the stars A and D would be of the order of 0·1″.

The observations made at Vienna in 1920–2, characterised by the unexplained shift in phase of about three days, could be reduced not only with the established period of almost exactly eight days, but also with 8/7 and 8/9 of a day, in accordance with the rule of alternative periods. The periods of about one day do not, however, satisfy the numerous American observations. AUTHOR.

1105. Spectroscopic Study of the Visual Binary Systems ζ Herculis and β Delphini. Y. C. Chang. *Astrophys. J.* 68. *pp.* 319–326, *Nov.*, 1928.

ζ Herculis has a period of 34·5 years. Its spectroscopic orbit could be determined from the available observations of the radial velocity. The sign of the inclination is found to be negative. Its spectroscopic elements are: $\mathrm{K} = 4{\cdot}6$ km./sec., $\gamma = -69{\cdot}8$ km./sec., $a \sin i = 707{,}600{,}000$ km., $\dfrac{m_2^3 \sin^3 i}{(m_1 + m_2)^2} = 0{\cdot}089$. A formula relating the mass-ratio and the parallax explicitly has been obtained in the form:

$$\frac{\mathrm{M}}{p} = \frac{a_1}{\mathrm{A}a}, \quad \text{where} \quad \mathrm{M} = \frac{m_2}{m_1 + m_2}.$$

The average of trigonometric and other parallaxes gives $p = 0{\cdot}099''$, from which $m_2/m_1 = 0{\cdot}88$.

6 β Delphini, discovered by Burnham as a close visual binary in 1873, has been observed for radial velocity for a time interval longer than

its period of revolution of 26·8 years. The following facts are obtained from a study of its velocity-curve determined from Yerkes spectrograms: K = 6·8 km./sec., $\gamma = -21\cdot0$ km./sec., $a \sin i = 857{,}000{,}000$ km., $\frac{m_2^3 \sin^3 i}{(m_1 + m_2)^2} = 0\cdot263$, $m_2/m_1 = 1$. The inclination is positive. AUTHOR

1106. Orbit of Spectroscopic Binary 30 τ Canis Majoris. O. Struve and A. Pogo. *Astrophys. J.* 68. *pp.* 335–340, *Nov.*, 1928.

The orbital elements of this spectroscopic binary of type O were derived from 43 spectrograms, of which 33 were obtained at the Yerkes Observatory, 7 at the Lick Observatory, and 3 at the Dominion Observatory, Ottawa. The spectrum shows the lines of the brighter component only. The velocity of recession of the system is 40·4 km./sec. The total range in velocity is 104 km./sec. The period is 154·80 days, longer than that of any other O type binary. The eccentricity is 0·36. The longitude of periastron is 102·5°. The foreshortened major semiaxis, $a_1 \sin i$, is 103,700,000 km.; assuming an average inclination and mass ratio, the corresponding mean distance of the two components of the system would be of the order of 2 astronomical units. The mass function is 1·86 ⊙, which is normal for a binary of spectral type O, and corresponds to an average total mass of 40 times that of the sun. AUTHORS.

1107. Spectrophotometric Observations of P Cygni. C. T. Elvey. *Astrophys. J.* 68. *pp.* 416–422, *Dec.*, 1928.

The intensities of the emission and absorption lines of P Cygni have been determined from single-prism spectrograms of the Dearborn Observatory taken on the following dates: October 16th, 22nd, 1927; March 21st, 23rd, April 13th, and 27th, 1928. There is a considerable variation of the intensities of the lines among the plates, but all of them show that the spectrum is of the normal P-Cygni type. The first spectrogram was obtained 20 days after the one taken at Harvard which showed the anomalous spectrum, indicating that the change must be of rather short duration. The suggestion is made, since only objective-prism spectrograms have recorded the abnormality, that the disappearance of the absorption line of Hβ, and sometimes Hγ, may be an effect of " bad seeing " and of " wind shake," when an objective-prism camera is used, rather than a change in the star itself. The ratios of the intensities, I_e/I_a, of the emission to the absorption lines are given. These decrease with the shorter wave-lengths. In the case of the helium lines the decrease has nearly the same rate for the various spectral series in the photographic region. AUTHOR.

1108. Investigations of Semi-Regular Variables. Secular Changes in Mean Period of R Scuti (1795–1927). B. P. Gerasimovič. *Harvard Coll. Obs., Circ. No.* 333. *pp.* 1–5, 1928.

R. Scuti is an interesting member of the intermediate group of variables which seem to link the Cepheids with the long-period variables. Few are subject to such large variations in the light curve, and spectroscopically the star is also peculiar, for it shows titanium-oxide bands at one phase. It has been constantly observed since its discovery by Pigott in 1795, and in this paper the mean period is determined from the observations. It is clear that there has been a secular increase, which amounts to $0^d\cdot64$ per decennium: the increase seems to be linear, but probably has actually proceeded by an accumulation of small jumps, and the straight line by which the curve is now represented may really be simply a small part of an extremely long sine curve, as in the case of R Hydræ. The character of the light and velocity curves of R Scuti indicates that we have not here a forced oscillation caused by an external and regular agency, but rather a composite free vibration, which is far from steady. This suggests that the variable is in a transitional state, and probably on the way to a more steady configuration of dynamical equilibrium, perhaps that of a long-period variable. There may be minor periods superposed on the period here found, but this is evidently the dominant period. M. A. E.

1109. Elliptical Elements of the System of "U Ophiuchi." G. Viola. *Accad. Lincei, Atti*, 8. *pp*. 489–496, *Nov*. 18, 1928.

The observations of Bemporad are so far the only ones which permit of the determination of the eccentricity of the orbit, and the orbital elements deduced from these are in accord with Shapley's data. A. D.

1110. Distances of the Stars. S. A. Mitchell. *Am. Phil. Soc., Proc*. 67. 3. *pp*. 267–286, 1928.

A historical review of scientific advance in measuring the distances of the stars, with a brief description of the most recent results, and of their value in extending our knowledge of the universe in various ways.

M. A. E.

1111. Thermodynamics of the Compton Effect with Reference to the Interior of Stars. S. Chandrasekhar. *Indian Journ. Phys*. 3. *pp*. 241–250, *Nov*. 30, 1928.

This paper deals with the statistical equilibrium of a system containing: (1) electrons and quanta, and (2) electrons, ionised atoms, and quanta. Expressions are derived for the ratio of the probability coefficients connected with the "Compton-type" collisions and "reversed Compton-type" collisions. The ratio is nearly unity in the first case and nearly $3{\cdot}3 \times 10^{27}$ in the second. This enormous difference is explained as due to the fact that the reversed Compton effect in the case of bound electrons is one of a triple collision and that with free electrons an ordinary double collision. On this basis the softening of the high-frequency radiation created in the interior of a star is attributed to the Compton scattering with bound electrons. AUTHOR.

1112. Stellar Radiation Measurements. E. Pettit and S. B. Nicholson. *Mt. Wilson Observat. Contrib. No*. 369. *Astrophys. J*. 68. *pp*. 279–308, *Nov*., 1928.

Measures of stellar radiation are discussed which were made during the period 1922 to 1927 with vacuum thermocouples attached to the Mount Wilson 100-inch telescope. The methods of constructing and of using the thermocouples are described. A table of 124 stars is given, reduced to a homogeneous system of radiometric magnitudes, heat-indices, and water-cell absorptions. The chief results of the observations are as follows: A lower temperature is indicated for giant stars than for dwarfs; red stars in general deviate from black-body conditions, but N-type stars radiate more like black bodies than M stars with the same water-cell absorption; for stars earlier than G5 the heat-index gives consistently higher temperatures than the water-cell; the diameters of stars have been determined, and are compared with those found by interferometer; Sirius is third in the list of radiometrically brightest stars, being inferior to Betelgeuse and Antares; radiometric variation has been studied in two eclipsing variables, in ten long-period and two Cepheid variables, and has been compared with the light-curves. M. A. E.

1113. Absorption Lines in Stellar Atmospheres. E. A. Milne. *Roy. Astron. Soc., M.N.* 89. *pp.* 3–17, *Nov.*, 1928.

There are two main models for a stellar atmosphere: (1) material, transparent except in line frequencies, supposed placed in front of a radiating surface radiating with " photospheric " intensity; (2) no surface of demarcation between atmosphere and photosphere, but a merging of the layers contributing the line opacity into those contributing the general opacity. Determinations of N, the number of atoms per cm.^{2} in a stellar atmosphere, presuppose (1). The actual facts must correspond much more closely to (2). Hence it is necessary to interpret values of N in terms of (2). The present paper shows how to calculate for any point of a line-contour the optical depth $\tau = \tau_0$ for which the following property holds. Let the atoms in (2) existing above $\tau = \tau_0$ be placed in front of the radiating surface in (1) and rendered transparent except in the line-frequency; then the two models give the same intensity-ratio at the chosen point of the line-contour r. For (1), the contour of an absorption band may be calculated (given the atomic absorption coefficient as a function of ν) by means of a Schuster formula; for (2) a different formula holds and the contour is slightly different. A fit of the two contours may be made at any desired place on the line-contour; this fit corresponds to a fixation of N, " the number of atoms above the photosphere," as determined by the method of Unsöld, and to an evaluation of the level $\tau = \tau_0$, the base of the column of N atoms; τ_0 measures the general opacity down to this level (*i.e.*, the opacity in the absence of an absorption line). Subject to a small correction, the value of τ_0 is $r/(r + 1)$, where r is the intensity ratio at the point of the line-contour where the fit is made. Unsöld's fits correspond to about $r = \frac{1}{2}$, which gives $\tau_0 = \frac{1}{3}$. As the fit is made farther out to the wings, r tends to unity and τ_0 to $\frac{1}{2}$. These values of τ_0 refer to integrated radiation from the whole stellar disc. Each determination of N by the method of Unsöld determines in effect a value of $\epsilon/\bar{\kappa}$, where $\bar{\kappa}$ is the mean coefficient of general absorption in the reversing layer and ϵ is the absolute abundance of the atoms in question, by mass (assuming N properly corrected for ionisation). Assuming that Na, Al and Ca form 10 per cent. by mass of the solar atmosphere, Unsöld's results give $\bar{\kappa} = 5 \cdot 5$ approximately. Rediscusses Schuster's theory of dark and bright lines in the stellar spectrum. A. D.

1114. Ionisation in Stellar Atmospheres. E. A. Milne. *Roy. Astron. Soc., M.N.* 89. *pp.* 17–49, *Nov., and pp.* 157–175, *Dec.*, 1928.

Formulæ are obtained for the total number N of atoms per cm.^{2} in a stellar atmosphere in a given state of ionisation r down to the level where the electron-pressure is P, allowing accurately for changes of ionisation from level to level with changing pressure. Formulæ are also obtained for the optical depth τ down to level P. These formulæ involve g, the acceleration due to gravity; and the later pages discuss the variations of N with g (absolute magnitude effects). A. D.

1115. Viscosity in the Stars. S. Rosseland. *Roy. Astron. Soc., M.N.* 89. *pp.* 49–53, *Nov.*, 1928.

Emphasises the importance of turbulent eddy motion in the stellar atmospheres, as compared with simplifying assumptions, such as laminar motion and the like. In regard to rotating stars, Jeans's radiation pressure theory (*Astronomy and Cosmogony*, p. 266) is wholly inadequate in face of the viscosity in turbulent eddy motion. Eddington's circulating convection currents (*The Internal Constitution of the Stars*, p. 284) work better, but not satisfactorily. A rigorous theory of the observed law of solar rotation will require a much more thorough analysis. A. D.

1116. Electrical Conductivity of Stellar Matter. S. Chapman. *Roy. Astron. Soc., M.N.* 89. *pp.* 54–57, *Nov.*, 1928.

Formulæ are found, on the basis of the kinetic theory of gases, for the electrical conductivity at different levels. A. D.

1117. Schwarzschild's Ellipsoidal Theory. W. M. Smart. *Roy. Astron. Soc., M.N.* 89. *pp.* 105–115, *Nov.*, 1928.

In any region in which there are N stars with proper motions from zero upwards the theoretical distribution of the proper motions, in relation to position angle, is derived on the ellipsoidal theory, when all proper motions below a definite value are excluded. A relation between $R(\mu)$, the total number of stars with proper motions of μ and above, and N is deduced in terms of the ellipsoidal constants. An analysis of a sample region according to the ellipsoidal and two-streams theories shows that differences between the distributions $y = R(\mu)$ given by the respective theories are negligible. A general formula expressing the ratio of the axes of the velocity ellipse (ellipsoidal theory) in terms of the constants of the two-streams theory is deduced. A notable difference in the respective frequency curves (with respect to position angle) of the larger proper motions according to the two theories referred to is indicated. J. S. G. T.

1118. Wide Absorption Band in Some B-Type Stars. W. J. S. Lockyer. *Roy. Astron. Soc., M.N.* 89. *pp.* 127–129, *Nov.*, 1928.

A series of photographic enlargements of the spectra of ϕ Persei (Sp. Type Bone η) all show a strong region of absorption in the same position in the spectrum [see Abstracts 2225 (1924), 2047 (1925), 2307 (1926) and 2970 (1928)]. The explanation by " absence of bright lines " is not tenable and the possibility of its being due to local absorption by the optical parts of the instrument has been considered but has not been found justified. The actual width is not easily stated and it varies in definition and displacement from star to star. The author considers that it is identical with that recorded in Vega by Shapley, who attributes it to Cyanogen, and who also eliminates the possibility of its instrumental origin [see also Abstract 438 (1929) and Harvard Coll., Bull. No. 862 pp. 1–3.] A. S. D. M.

1119. Galactic Rotation Derived from Boss's P.G.C. Proper Motions. J. Schilt. *Astron. J.* 39. *pp.* 17–20, *Nov.* 19, 1928.

The author had found a 12-hour term in the differential rotation of the stellar system both from the proper motions in Gyllenberg's Catalogue [see Abstract 302 (1928)] and in Prager's [see Abstract 2646 (1928)]; these periodic terms can be explained by a proper motion in galactic longitude

P cos 2 $(l - l_0)$, where P = const = 0″·009 nearly per year. But Oort derived a very small value for P = 0″·0018 ± 0″·0010 from Boss's P.G.C. proper motions, requiring luminosities too great for the various stellar types, and the author considers that the discrepancy may be due to systematic errors tending to mask the rotational term in cos 2 $(l - l_0)$. Probably Boss's catalogue contains such errors depending on α or δ, or both, rather than errors periodic in 2α. He tries a solution based only on the second harmonics of the proper motions in R.A. and Dec., and studies the residuals O − C as given by Boss for 124 trapezia. He finds that his results confirm his value for P from Gyllenberg and Prager, and that the apparent direction of the centre of the stellar system is at an appreciably greater galactic longitude than that indicated by Oorts's treatment of the radial velocities which are primarily based on early B stars and *c* stars, whereas the catalogue average type star lies between A and G. These latter give for the centre 341° ± 6°, but the B and *c* stars give 322° ± 2°. A. S. D. M.

1120. Photographic Chart of Northern Milky Way. C. Easton. *Roy. Astron. Soc., M.N.* 89. *pp.* 207–209, *Dec.,* 1928.

Two charts of galactic longitudes 0°–90° and 90°–180° have been formed from a combination of available photographs of the Milky Way. The stars have been inserted from data furnished by A. Marth. The general picture is the result of a minimum bias on the part of the draughtsman. The author points out the very striking and undoubtedly real feature of an extensive system of streamers, between δ Cassiopeiæ, the Pleiades, β Tauri, and δ Aurigæ, converging to the central parts in Auriga and Perseus, of which the great system of streamers in Orion seems to form a complement. A. S. D. M.

1121. Studies of the Galactic Centre. Part I. Milky Way Variable Stars. H. Shapley. *Nat. Acad. Sci., Proc.* 14. *pp.* 825–830, *Nov.,* 1928.

In order to discover the details of galactic dimensions and structure, and in particular the nature of its central regions, special researches are now being carried on at Harvard College Observatory. An extensive observing programme of faint variable stars was begun five years ago, and will be maintained for ten or fifteen years longer; for not only typical Cepheids, cluster-type variables, and long-period variables, but to a lesser extent novæ and eclipsing binaries can all be used in measuring distances. This paper briefly describes the methods and instruments used, and gives the number of new variables discovered since the programme was drawn up. M. A. E.

1122. Studies of the Galactic Centre. Part II. Preliminary Indication of a Massive Galactic Nucleus. H. Shapley and Henrietta H. Swope. *Nat. Acad. Sci., Proc.* 14. *pp.* 830–834, *Nov.,* 1928.

The work on a selected field of 70 square degrees in Scorpio and Ophiuchus, near the accepted centre of the Galaxy, is here described. The number of known variables in this very rich region is now 450, the types have been determined for about 165, and periods and light curves for 70. By their means the distance of this star-cloud has been determined, and is found to be the same as the distance of the galactic centre calculated from the distribution of the globular star-clusters. Lanes of obscuring nebulosity cut off this bright star-cloud from the other very rich regions across the galactic equator in Sagittarius and neighbouring constellations, but behind the dark nebulosity the star-clouds are doubtless dense and continuous. A massive galactic nucleus is indicated, at a distance of nearly 50,000 light-years. It is intended to carry on the detailed analysis of faint variables in the Sagittarius clouds. M. A. E.

1123. Absolute-Magnitude Dispersion of Giant M Stars. G. Strömberg.

Nat. Acad. Sci., Proc. 14., *pp.* 834–838, *Nov.*, 1928.

The problem of finding the distribution according to absolute magnitude of a group of stars is important, and can only be solved (unless all the stars are at approximately the same distance) by making some assumptions as to the nature of the distribution function. A solution is here given for the case in which it is assumed that the distribution of absolute magnitudes in the group is that corresponding with a normal error distribution, and it is reached by comparing the distribution of angular velocities with that of the radial velocities. It is compared with Gyllenberg's solution of the same problem, and with Luyten's work on the frequency of absolute magnitudes of giant M stars derived from the spectroscopic data of Adams, Joy and Humason. M. A. E.

1124. Giant and Dwarf Stars of Type K0. F. Dyson.

Roy. Astron. Soc., M.N. 89. *pp.* 116–124, *Nov.*, 1928.

From data relating to parallax and proper motion it is concluded that in North declination there are, within 50 parsecs. of the sun, 2 K0 stars of absolute magnitude $1^m\cdot 0$ $0^m\cdot 0$, 13 of magnitude $0^m\cdot 0$ to $1^m\cdot 0$ and 24 of magnitude $1^m\cdot 0$ to $2^m\cdot 0$. This distribution of magnitudes tends to take the form of an error curve. " Giants " are most numerous near magnitude $1^m\cdot 0$, and dwarfs are most numerous near $6^m\cdot 0$. J. S. G. T.

1125. Low Colour-Temperatures of Some Early-Type Stars with Strong Ca^+ Lines. W. H. M. Greaves, C. Davidson and E. Martin.

Roy. Astron. Soc., M.N. 89. *pp.* 125–127, *Nov.*, 1928.

The B1-type star ζ Persei is approximately of the Colour A5-type and has the most intense K line of any early-type star down to magnitude 3·0. The authors have observed the colour-temperatures of 9 Cephei and α Camelopardi, which also have intense Ca^+ lines. They give a table for eight early types (including some with weaker Ca^+ lines) of the values of the gradient G observed at Greenwich; $G = k - C_2T^{-1}(1 - e^{-c_2/\lambda T})^{-1}$, where T = colour-temperature; $C_2 = 14{,}300$; and λ (measured in microns) $= 0\cdot 5$ and is the mean wave-length of the spectral range used; k is a constant adjusted so as to make the mean gradient of A_0 stars equal to zero. In this table the four stars with stronger Ca^+ lines are redder than the average Ao star; and it is suggested that the light is reddened by passing through an insterstellar calcium cloud. The parallax of α Camelopardi derived from 25 plates at Greenwich is $+ 0''\cdot 023 \pm 0''\cdot 007$, and if this is confirmed, its nearness to us is unfavourable to Eddington's view that calcium absorption takes place uniformly through space. A. S. D. M.

1126. Stellar Parallaxes Determined at Royal Observatory, Greenwich. F. Dyson.

Roy. Astron. Soc., M.N. 89. *pp.* 130–132, *Nov.*, 1928.

In continuation of the results obtained with the 26-inch telescope and published annually in the *M.N.*, November number, a list is given of 30 stars with name and B.D. number; magnitude, visual and photographic; spectral type; R.A. and Dec. for 1900·0; proper motion, both from meridian observations and relative; parallax; probable error; and number of plates on which it is based. In calculating the parallax, the relative proper motions are used, *not* the meridian proper motions. A. S. D. M.

1127. Determination of Constants of Position of Orbit from its Elliptic Elements. T. Banachiewicz. *Roy. Astron. Soc., M.N.* 89. *pp.* 215–217, *Dec.*, 1928.

The six direction cosines (P_x, P_y, P_z, Q_x, Q_y, Q_z) of the major and minor axes of a heliocentric orbit, together with the three direction cosines (R_x, R_y, R_z) of a normal to the plane of the orbit, are expressed in this paper by formulæ of a new kind involving the ecliptic elements ω, i, Ω, and the obliquity ϵ of the ecliptic. The author uses and defines certain mathematical forms, the " matrices-cracovians " differing from the Cayley matrices in the definition of the products. He gives alternative methods of calculating P_x . . . Q_z, recommending the second method as shorter; but the interest of the second method lies in the fact that it gives an independent check on the methods obtained by the first method.

A. S. D. M.

1128. Determination of Apex by Means of G-Type Stars. J. M. Mohr. *Comptes Rendus*, 187. *pp.* 929–931, *Nov.* 19, 1928.

By using the radial velocities and parallaxes of 519 G0–G9 stars of the type so designated by Mount Wilson and Victoria, with a few K stars from the Harvard type, and the proper motions from the Boss and Cincinnati catalogues, the author shows from two curves with velocities as abscissæ and the Declinations and Right Ascensions respectively as ordinates, that, for both giants and dwarfs, a minimum exists at 30–40 km. and at 70–80 km. in absolute velocity, and a pronounced maximum at 40–50 km.; also that there is a minimum at 30–40 km. for giants, at 40–50 km. for dwarfs, and for both types a maximum at 60–70 km. and a feeble minimum at 80–90 km. Kaburaki has obtained similar results for type K stars. The author concludes that the resultant absolute velocity of giant stars in any group is parallel to that for dwarfs in the same group, and that there is no great difference in space velocity between the two types. If V is an exponential function of the absolute velocity (v), $\log V = a + bv$, then $\log V = 1{\cdot}120 + 0{\cdot}0061\,v$ for giants and $= 1{\cdot}304 + 0{\cdot}0048\,v$ for dwarfs.

A. S. D. M.

1129. Short-Period Terms in Time Determinations by Meridian Transit Observations. N. Stoyko. *Comptes Rendus*, 187. *pp.* 931–933, *Nov.* 19, 1928.

The influence of short-period lunar terms (which may exceed 0·02 second) is not negligible in view of the actual precision of time determination, but such terms are neglected often because of the work involved in the calculations for each star. The author gives approximate formulæ, using the notations of his preceding notes [see Abstracts 81 and 765 (1929)] for the two cases where account is not taken of these terms either for clock or circumpolar stars, and where account is taken for circumpolar but not for clock stars. A. S. D. M.

1130. New Comparator for Measurement of Radial Velocities. M. Hamy. *Bull. Astronomique*, 5. 6. *pp.* 395–403, 1928.

The spectrograph now attached to the great equatorial coudé does not give spectra, uniform in density of sufficient width for precise measurement. The author has adapted his device for Hartmann's method, which allows a direct comparison between stellar and solar spectrograms. A diagram of the device is given, and the means of eliminating the difficulties hitherto found in the measures of spectra of very small width are described. The regulating equipment is simple and easy, but it has to be operated in a particular order, for which eight rules are given. The order of precision is attained by comparing the solar spectrum with another solar spectrum greatly reduced in width; there is no difficulty in operating with spectra as narrow as 0·1 mm. A. S. D. M.

1131. Absorption of the Calcium K Line by Intersellar Calcium. H. A. Wilson. *Astrophys. J.* 68. *pp.* 423–425, *Dec.*, 1928.

In this note it is shown that O. Struve's results [see Abstract 2648 (1928)] on the absorption of the detached calcium line K by interstellar calcium vapour agree approximately with the equation $I = I_0 e^{-k\sqrt{Nd}}$, where I/I_0 is the fraction of the light absorbed, d the distance of the star source, and k and N are constants. AUTHOR.

1132. Unity of the Universe. H. D. Curtis. *Roy. Astron. Soc. Canada, J.* 22. *pp.* 399–412, *Dec.*, 1928.

Deals with the probability of the unity of the universe from the point of view of space, time, material and energy. In macroscopic structural features the universe displays a remarkable continuity. It may be infinite, and if it is dynamically stable, it must consist of systems of successively decreasing density. The unity of the material of the universe may be taken as established by spectroscopic evidence. The statistics of novæ show that such cataclysms happen about six times per annum to stars within our galactic system. Thus it would happen to any star in about 166 million years, which is a relatively short period in the life of a star. E. E. F. d'A.

LIGHT.

1133. Measurement of Refractive Indices in the Ultra-Violet. C. Fabry and J. Barot. *Rev. d'Optique*, 7. *pp.* 429–433, *Nov.*, 1928.

The refractive indices of transparent optical substances are usually measured by visible radiations. It is often useful, however, to know the refractive indices for ultra-violet light. This involves the use of a photographic method, and this paper describes such a method, using only one plate. The specimen for which the refractive index is required is cut into a 60° prism and then mounted on the table of a spectroscope, with photographic attachment in such a manner that the face of the prism at which the rays leave it, is perpendicular to the rays from the collimator. With the prism in this position a spectrogram is taken and then superposed on this spectrogram a series of direct images of the slit, taken at known angles from the original position of the slit and collimator, with the prism raised, are photographed. Measuring the distances of any line from two such slit images, the angle of deviation for that wave-length can be obtained. The refractive index is connected by a simple relation, with the prism angle and the angle of deviation. R. C. F.

1134. Absorption of Ultra-Violet Light in Ozone. A. Läuchli. *Helv. Phys. Acta*, 1. 3 *pp.* 208–236, 1928. *In German.*

The author measured the absorption coefficient (α) over the range 238–334 $\mu\mu$, using a differential ozone meter. Ozone could be produced in either of the two vessels by electrodeless discharge and its content determined by pressure difference. Two quartz spectrometers, one behind the other, are used to increase the dispersion, and a sensitive photoelectric measuring apparatus is employed. Scattered light appears over the whole spectrum, and corrections have to be applied to all the measured intensities, these being more important at some points than at others. The absorption coefficients found differ most from former values in the region 238–280 $\mu\mu$, but for longer waves the absorption is less and the corrections smaller. Above 270 $\mu\mu$ the agreement with Fabry and Buisson is good, but for shorter waves higher absorption coefficients are found, probably caused by uncertainty in the O_3 and intensity determinations. For the region 280–335 $\mu\mu$ the author gives the equation $\log \alpha = 16 \cdot 74 - 0 \cdot 0536\,\lambda$, when λ is given in $\mu\mu$. R. S. R.

1135. Structure of the Colour Body in the Region of Light Perception. N. Nyberg. *Zeits. f. Physik*, 52. 5. 6. *pp.* 406–419, 1928.

The paper is based on Grassmann's treatment of the region of light-perception as a vector space of three dimensions (*Phil. Mag.*, 1854). Each light perception can be characterised by three definite integrals taken over the visible spectrum, and these integrals are measured along three orthogonal axes, giving a colour body or space which is independent of any physiological assumptions. The treatment enables a critical judgment of Ostwald's theory of colour to be made, and sets forth a new theory on the lines of the work of Grassmann and Helmholtz. G. E. A.

1136. Theory of Vision: Failure of Talbot's Law. E. Haschek. *Akad. Wiss. Wien, Ber.* 137. 2*a*. No. 8. *pp.* 513–528, 1928.

The author proposes a photochemical theory of colour vision postulating a threefold visual substance corresponding to the three colour sensations of the Young-Helmholtz theory. The visual sensation arises from the decomposition of these visual substances. The curve connecting rate of decomposition per unit illumination with the wave-length of the light is a resonance curve. The sensation curve arises from the response of the nerves to this decomposition process. On the basis of this hypothesis various phenomena of vision may be explained, notably the change of colour of a given radiation noticed after prolonged exposure of the eye to light, the decrease of saturation of all coloured light with increase of intensity, and the departures from Talbot's law found experimentally when the times of individual exposures are exceedingly short (of the order of 0·001 to 0·0001 sec.). The Purkinje effect is also explained on this theory. J. W. T. W.

1137. Decrease of Visual Sensitivity with Exposure. H. Schober and Margarethe Triltsch. *Akad. Wiss. Wien, Ber.* 137. 2*a*. *No.* 8. *pp.* 539–550, 1928.

In order to test Haschek's theory of the visual mechanism [see preceding Abstract], the authors determined the rate of fall of sensitivity of the retina with continued exposure. One part of the retina was exposed to a constant brightness for a specified length of time and a neighbouring portion was then suddenly exposed to a different (lower) brightness. By trial and error, the lower brightness observed to match the exposure brightness after any given length of exposure was determined. In this way it was possible to draw curves of decrease of sensitivity of the retina with lapse of time. The form of these curves was found to be in satisfactory agreement with the mathematical expression deducible from Haschek's theory, and the constants involved in his hypothesis could be evaluated. J. W. T. W.

1138. Use of Prismatic Objective to Determine Radial Speeds. P. Rossier. *Arch. des Sciences,* 10. *pp.* 280–284, *Sept.–Oct.,* 1928.

The author explains the arrangement of an apparatus by which two parabolic mirrors are employed to reflect the light to the photographic plate. In making the tests another bright star is used near the one studied and whose radial speed is known. The apparatus is compact and its length only half the focal distance. R. S. R.

1139. Fringes of Parallel Networks. L. Lenouvel. *Rev. d'Optique,* 7. *pp.* 395–402, *Oct.,* 1928.

The author explains on theoretical grounds the fringes formed when two screens, each consisting of a series of equidistant parallel lines, are used one behind the other. The screens are arranged to have a line in one screen covering a slit in the other. The properties of the fringes formed are discussed both when monochromatic and white light are used. These characteristics of the fringes may be applied as a means of testing lenses. If the lens is uniform the fringes are undisturbed, but if aberration exists the fringes are distorted. R. S. R.

1140. Ellipticity of Vibrations Transmitted by Laminæ of Magnetised Iron. O. Specchia. *N. Cimento,* 5. *pp.* 361–375, *Nov.,* 1928.

An old experiment of Righi's (*Mem. R. Acad, Bologna,* 7. *Ser.* 4) repeated with the view of ascertaining whether the ellipticity of transmitted vibrations is independent of the thickness of the film, as Righi thought it was, or whether it increases with the thickness of the film in accordance with Cotton's theory that there is circular dichroism. The latter was found to be the case. A. D.

1141. Transmission of Ultra-Violet Radiations by Quartz Prism Monochromators. W. T. Anderson, Jr., H. D. Fraser and L. F. Bird. *J.O.S.A. and R.S.I.* 17. *pp.* 454–462, Dec., 1928.

The relative ultra-violet transmission of a crystal quartz Cornu prism monochromator with respect to wave-length was obtained directly by means of a Bi-Ag thermopile, employing monochromatic radiation and measuring the incident and transmitted energy. By a consideration of the measured spectral energy distribution of the quartz H*g* arc the actual transmission between 4045 Å and 2480 Å was calculated. When the relative transmission is corrected for lens action the values agree excellently with calculated amounts. For ultra-violet radiations about 11 per cent. was transmitted, while the energy content ranged from 5×10^3 erg/sec. at 3660 Å to $1 \cdot 8 \times 10^3$ erg/sec. at 2537 Å. An outline is given of a filter method used to determine the total ultra-violet energy from a light source. R. S. R.

1142. Effect of Thickness and Light Intensity on Colour Filters. G. Jaeckel. *Zeits. f. techn. Phys.* 9. 12. *pp.* 479–482, 1928. *Paper read before the Deut. Naturforscher u. Ärzte, Hamburg, Sept.*, 1928.

Shows how the colour of a filter may change as its thickness is altered. With certain types of spectral transmission curve this change may be very marked, *e.g.* from green to red. When the cut-off is very sharp the effect of thickness is necessarily small. In the case of a filter which transmits at least some light at all wave-lengths, the effect of increasing the intensity of the light viewed through the filter is to increase the approximation to whiteness, *i.e.*, to decrease the apparent coloration produced by the filter. J. W. T. W.

1143. Glare Due to Coloured Filters. G. Jaeckel. *Zeits. f. techn. Phys.* 9. 12. *pp.* 482–484, 1928. *Paper read before the Deut. Naturforscher u. Ärzte, Hamburg, Sept.*, 1928.

The eye moves over the field of view so that, if there is a sharp contrast between two neighbouring areas, there is a sudden change of illumination on the same portion of the retina as the fixation point moves. With white light, the chromatic aberration of the eye produces a haziness at the edge of the image of a bright area. When a filter is used to limit the spectrum to a narrow range, this haziness is removed. In consequence the transition from dark to light is made more sudden and the effect is one of glare. This can only be noticed at high intensities, since when the pupil is dilated, spherical aberration performs the same function as chromatic aberration. J. W. T. W.

1144. Mounting for Plane Grating. G. S. Monk. *J.O.S.A. and R.S.I.* 17. *pp.* 358–364, *Nov.*, 1928.

Owing to the disadvantages of the plane grating in the ordinary Littrow mounting, the present author has developed a type of mounting which eliminates quite a number of these objections. It consists of a concave mirror which reflects the light on to the grating at an acute angle, the focal curve of the system being a lemniscate. The theory of the mounting is discussed, and it is shown to possess the following advantages: the plane grating is available for the ultra-violet and can be used to photograph simultaneously all wave-lengths in several orders; concave mirror makes possible the use of a larger cone of light from the source; mirror can be coated for special spectral regions; concave mirror cheaper than a large aperture lens; reflections, as in Littrow mounting, absent; no extensive adjustments for focus and tilt are necessary. Certain disadvantages should be noted: the astigmatism of the spectrum is greater than that of the Rowland mounting for positions normal to the grating; the focal curve is not a circle; fewer orders can be used than in the Littrow mounting. R. C. F.

1145. Locus of Secondary Image for Two-Plane Mirrors. L. E. Dodd. *J.O.S.A. and R.S.I.* 17. *pp.* 369–378, *Nov.*, 1928.

The present problem, in geometrical optics, deals with a more general case of inclined mirrors than the simpler and familiar ones of the kaleidoscope, the "hinged mirrors," and the sextant. Here each of the two plane mirrors has its own independent axis in its own plane, the two axes being, however, parallel to each other, which requires that the intersection line of the two reflecting planes be always parallel to the two axes, but it may otherwise be located anywhere in space. The problem is stated so as to involve three parameters, in addition to the two independent variables. The main problem is that of the locus of the secondary image, O'', under these conditions. Derivations are given also for the locus of the primary image, O', and for the intersection, C, of the mirror planes. From the geometrical standpoint the problem is that of two related isosceles triangles, $O'AO$, $O'A_0O''$, where O is the object point and A, A_0, are the points where the mirror axes cut the principal plane, all five points being coplanar. The problem is made more general physically by supposing that the mirrors are half-silvered. The geometrical situation is expressed also in terms of intersecting circles, useful for graphical construction. AUTHOR.

1146. New Machine for Measuring Displacements on Stellar Spectrograms. M. Hamy. *Astrophys. J.* 68. *pp.* 403–407, *Dec.*, 1928.

This new machine, applying Hartmann's method of comparing a stellar spectrogram with one of the sun, is so arranged that the very narrow stellar spectrum can be measured and need not be widened during the exposure. When only one side of the machine is used, the ordinary method of reduction can be followed. AUTHOR.

1147. Use of Lenses in Series for Sight Testing. T. Smith. *Optical Soc., Trans.* 29. 5. *pp.* 243–250, 1927–1928.

The paper deals with the theory of a train of lenses placed in series as used in a trial frame or other instrument. The series arrangement enables a small number of lenses to be combined to give the correction for any regular defect of form. It is shown that in general effective powers are not simply additive, but under the conditions described in the paper the error made in regarding them as additive becomes small. The conditions involve the order of the lenses and the position of every lens except the first of the train. It is always possible to satisfy these conditions in a system designed for use in the way described. With incorrect arrangements serious errors may be made. AUTHOR.

1148. Telephoto Lenses in Astronomical Spectrographs. P. W. Merrill. *Astrophys. J.* 68. *pp.* 425–426, *Dec.*, 1928.

A telephoto lens, which, however, should be specially designed for the purpose, has certain advantages as the collimator of an astronomical spectrograph. These are mechanical (compactness of instrument) and not optical. AUTHOR.

1149. Optical Properties of Potassium and Cæsium. J. B. Nathanson. *J.O.S.A. and R.S.I.* 17. *pp.* 343–349, *Nov.*, 1928.

The optical constants of potassium and cæsium were determined for the solid and liquid states. Observations were made at temperatures above and below the melting points of the metals. The glass cell containing the alkali mirror was heated by means of a small electrical oven enclosing the mirror and containing suitable apertures for the incident and reflected light rays. The method of observation was that employed in previous investigations. The optical constants were computed by means of Drude's equations. When the metal changed from the solid to the liquid state, it was found that the angle of azimuth of restored plane polarisation, as well as the phase difference of the components of the light vector parallel and perpendicular to the plane of incidence, changed by only a small amount. After due allowance for the effects of strains in the glass cells, it was concluded that the optical properties of the liquid alkali surface are closely identical with those of the solid alkali surface. AUTHOR.

1150. Practical Electrical Lamp for Illumination of the Ultra-Microscope. C. Spierer. *Arch. des. Sciences,* 10. *pp.* 276–279, *Sept.–Oct.*, 1928.

A metallic filament lamp is arranged inside a box, having circular openings on two opposite sides. The axis of symmetry of the lamp is parallel to the axis of rotation of the microscope mirror and the illumination of the field is that of a filament seen in profile. Achromatic collimating lenses concentrate the light on the mirror. Figures illustrate the greater uniformity of the field illumination obtained in this way. R. S. R.

1151. Ultra-Violet Microscopy. L. C. Martin and B. K. Johnson. *J. Sci. Instruments,* 5. *pp.* 337–344, *Nov., and pp.* 380–386, *Dec.*, 1928.

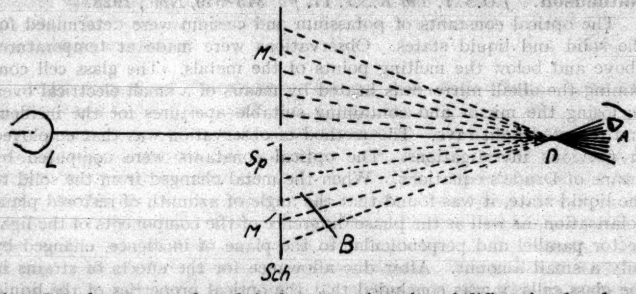
The paper describes experiences encountered in trials of various methods of ultra-violet microscopy. The selection with the aid of the interferometer of the fused quartz for the objective; the arrangement of the illuminating systems; old and new methods of finding the ultra-violet focus; the mechanical requirements of the microscope; the control of the immersion fluid by the use of non-hygroscopic mixtures, and the investigation of the resolving power of ultra-violet systems are among the subjects discussed. AUTHORS.

1152. Interference Measurement of Ultra-Microscopic Particles. U. Gerhardt. *Zeits. f. techn. Physik,* 9. 12. *pp.* 486–489, 1928. *Paper read before the Deut. Naturforscher u. Ärzte, Hamburg, Sept.*, 1928.

Describes an adjustable double aperture for use with a microscope in the measurement of the diameter of small particles of sizes ranging from 2μ downwards. A **V**-shaped slit is moved across a single-line slit oriented at right angles to the axis of the **V**. In this way, as the **V** moves over the line, the two almost punctiform apertures move towards or away from each other. J. W. T. W.

1153. Optical Micrometer for Measuring Fine Threads. I. Runge. *Zeits. f. techn. Physik,* 9. 12. *pp.* 484–486, 1928. *Paper read before the Deut. Naturforscher u. Ärzte, Hamburg, Sept.,* 1928.

The principle of the apparatus is shown in the figure. L is a lamp with single horizontal filament. S*p* is a slit in a screen S*ch*. D is the thread to be measured and A the eye. A series of diffraction bands are produced by D, and these are seen by the eye as if they were situated at B. The distance between the bands, related to the dimensions of the apparatus, gives the diameter of D with an accuracy of about 0·25 % when the diameter is of the order of 10 to 80 μ. J. W. T. W.



1154. Quantum Theory of Optical Activity. L. Rosenfeld. *Zeit. f. Physik,* 52. 3–4. *pp.* 161–174, 1928.

A general formula for rotatory power is deduced in the form

$$\theta = \frac{2\pi\nu}{c}\,\frac{\Delta n}{2} = \frac{2\pi^2\rho}{\lambda^2}.$$

This agrees with Biot's law, which can be regarded as an approximation to the more accurate formula of Drude. T. M. L.

1155. Photographs of Coronæ in Monochromatic Light. M. N. Mitra. *Indian Journ. Phys.* 3. *pp.* 175–180, *Nov.* 30, 1928.

Gives a review of the work done by Mecke, Mie, Ray and Blumer on the coronæ seen about a source of light viewed through a cloud of small spheres of water. In none of the experimental work has monochromatic light been used. The author has prepared a number of photographs of coronæ seen through clouds of water droplets of uniform size, using 4358 Å. radiations from the quartz mercury arc; the photographs are reproduced and are arranged in the order of the size of the drops. The rings differ greatly from the simple type of Fraunhofer diffraction pattern due to an opaque spherical obstacle. The changes observed with change in size are very striking and rapid, the whole system seeming to oscillate. H. N. A.

1156. Diffraction of Light at Wide Slits. H. Greinacher. *Helv. Phys. Acta,* 1. 4. *pp.* 263–272, 1928. *In German.*

Experiments are described in which Fresnel diffraction phenomena

were obtained using a wide slit. It is shown how they may be used to determine the wave-length and velocity of light in different media.
W. S. S.

1157. Photoelectric Cells in Polarimetric Measurements. G. Todesco. *N. Cimento,* 5. *pp.* 376–390, *Nov.,* 1928.

Application to the measurement of minimal rotations of the plane of polarisation of light of the method previously proposed [see Abstract 2102 (1928)]. The method is capable of dealing with rotations of the order of one second of arc. A notable increase in sensitiveness is obtained by setting the nicols at a certain angle, determined experimentally. A. D.

1158. Measurements of the Albedo at Artificial Cloud Layers. E. Regener. *Zeits. f. phys. Chem.* 139. *pp.* 416–424, *Dec.,* 1928.

A series of tests was made with clouds formed by (1) SO_3, (2) NH_4Cl, (3) paraffin-oil vapours, and (4) liquid air and ether vapour. Sunlight was observed by means of a Martens polarisation photometer when diffusely reflected from the upper surface of these artificial clouds. When the upper surface was sharp and the particle concentration very high, the albedo was 1·0 for (1) and (3), 0·96 for (2) and 0·90 for (4), comparisons being made with a slab of gypsum. A decrease in the particle concentration or lack of sharpness in the upper surface of the cloud led to a smaller value for the albedo. R. S. R.

1159. Precise Registration of Very Small Currents: Applications to Light Measurements. C. Müller and R. Frisch. *Zeits. f. techn. Physik,* 9. 11. *pp.* 445–451, 1928. *Paper read before the Deut. Naturforscher u. Ärzte, Hamburg, Sept.,* 1928.

Describes applications of Müller's method of registering very small currents with great accuracy [see Abstract 2117 (1928)]. These applications include the determination of spectral transmission or reflection curves using a photoelectric cell, the registration of spectrograms, of the luminescence decay curves of photo-luminescent materials, of the decay curves of radioactive materials, etc. One section of the paper describes a proof of the accuracy of Talbot's law for photoelectric cells, while the determination of the absorption and reflection characteristics of thin metal films in the ultra-violet is described. J. W. T. W.

1160. Visible Radiation Characteristics of Incandescent Oxides. Marcella L. Phillips. *Phys. Rev.* 32. *pp.* 832–839, *Nov.,* 1928.

The visible radiation characteristics of various oxides and oxide mixtures, when heated to red brightness temperatures between 1400° and 2000° K. by means of kathode-ray bombardment, and gas-air and oxy-gas flames, were measured by means of a disappearing filament type of pyrometer. Values of the red brightness temperature at $\lambda = 0{\cdot}665\ \mu$, the red-blue intensity ratio (λ for the blue $= 0{\cdot}467\ \mu$), and the candles emitted per square centimetre of surface were obtained. The oxides and mixtures examined, which were generally pressed or fused, were urania, ceria, lanthana, neodymia, erbia, yttria, zirconia, thoria, alumina, beryllia, magnesia and mixtures of thoria with 1 % of ceria, urania, neodymia and magnesium oxide. In general, linear relations were found between the logarithm of the red-blue intensity ratio and the reciprocal of the red brightness temperature, and between the logarithm of the brightness in candles per square centimetre and the logarithm of the red brightness temperature. This linear relation differed for different oxides, and for different methods of heating the same oxide. A table is given of the relative brightness in the blue part of the spectrum, and the candles per square centimetre for red brightness temperatures of steps of 100° K. from 1400° to 2000° K. R. C. F.

1161. Energy Distribution from Incandescent Solids. L. L. Holladay. *J.O.S.A. and R.S.I.* **17.** *pp.* **329–342,** *Nov.*, **1928.**

Gives, by means of curves and tables, the following information regarding the spectral distribution of the energy radiated from a black body at different temperatures: (*a*) the ratio of the energy at wave-length λ to the energy at the wave-length of maximum energy emission; (*b*) the portion of the whole energy emission which is contained within the spectral region from $\lambda = 0$ to $\lambda = \lambda$; (*c*) the percentage of energy emitted in the spectral region between $\lambda = 0$ and $\lambda = \lambda$ for black-body radiators at certain temperatures; (*d*) the percentage of radiant energy emitted in four given spectral regions by a black body at various temperatures: these regions are $\lambda = 0$ to 3000 Å., 3000–4000 Å., 4000–7600 Å. and 7600 Å. to infinity.

In the second part of the paper the same information is given for non-black body radiators, particularly tungsten. It is pointed out that when the spectral-energy distribution curve of tungsten at a certain temperature is compared with that of a black body at the colour temperature of the tungsten, the spectral distribution is the same throughout the visible and probably also in the ultra-violet and the near infra-red. For the greater part of the infra-red region, however, the distribution is different. J. W. T. W.

1162. Camera for Making Parallax Panoramagrams. H. E. Ives. *J.O.S.A. and R.S.I.* **17.** *pp.* **435–439,** *Dec.*, **1928.**

Particulars are given of a camera designed to permit lateral motion of the lens and plate holder along a track, their relative positions being governed by a rod pivoted to one side of the object which is to appear in the plane of the final picture. The operation of the camera is explained. The parallax panoramagrams so obtained show a relief picture at all distances and at any angle. The author discusses the results obtained.

R. S. R.

1163. Dependence of the Resolving Power of a Photographic Material on the Wave-Length of the Light. O. Sandvik and G. Silberstein. *Kodak Research Lab. Comm. No.* **344.** *J.O.S.A. and R.S.I.* **17.** *pp.* **107–115,** *Aug.*, **1928.**

A continuation of work on the dependence of resolving power on different factors [see Abstracts 1734 (1927) and 3004 (1928)]. The region of wave-lengths investigated was from 380 $m\mu$. to 725 $m\mu$. The method, as before, was to photograph in a reducing camera a parallel-line test-object consisting of groups of parallel lines with equal-width spaces between. In this way six different photographic plates were investigated. All showed a maximum resolution in the violet and near ultra-violet. Emulsions containing no sensitising dye have minimum resolving power at 535 $m\mu$.; while in orthochromatic and panchromatic emulsions containing dye sensitisers it is shifted to 485 $m\mu$. The relation between resolving power and wave-length is probably largely determined by the absorption and scattering characteristics. A. C. M.

1164. Standardised H and D Curves in Sensitometry. O. E. Conklin. *J.O.S.A. and R.S.I.* 17. *pp.* 463–465, *Dec.*, 1928.

Describes the method of making a family of standardised H and D curves, printed on a transparency, for facilitating the determination of the H and D constants of an experimental curve. The standardised curves all have their gammas and numbers describing the under-exposed region printed on them, whilst they also have indices for locating the position of the experimental curve and thereby determining its speed. In applying the curves, one other condition, that of raising or lowering the standard curves with respect to the exposure axis of the experimental curve, is found to be necessary for a fit. This is due to the fact that the intersection of the H and D curves with the exposure axis differs in abruptness and is termed "straightness" by the author. In comparing an experimental curve with these standard curves, the gamma is first determined for the experimental curve. This limits the number of curves to be tried, and these are further limited by an examination of the under-exposed region. The speed is determined by fitting the whole curve with a consequent increase in the accuracy of the values obtained. R. C. F.

1165. Aerial Photography. P. Seliger. *V.D.I.* 72. *pp.* 1749–1754, *Dec.* 1, 1928.

A general outline of the science of aerial photography and of its uses. The film, shape of picture and film development, types of aeroplanes used and actual aerial cameras are considered, both historically and as used at the present time. R. C. F.

1166. Aerial Photography. P. Seliger. *V.D.I.* 72. *pp.* 1908–1914, *Dec.* 29, 1928.

The author in a previous paper [see preceding Abstract] has described the apparatus used for taking aerial photographs, whilst, in the present paper, a description is given of the apparatus used for obtaining maps from these photographs. After a brief outline of the principles involved, the cases of flat and mountainous country are considered, together with the different types of apparatus necessary, including stereoscopic methods. R. C. F.

1167. Photographic Applications of Diazo Compounds. D. A. Spencer. *Phot. J.* 68. *pp.* 490–494; *Disc*, 495–496, *Dec.*, 1928.

Details the necessary conditions which had to be satisfied before a suitable diazo-sensitised paper could be produced, and which have delayed the development of the process. The question of stability of the diazo compounds is then theoretically dealt with, after which a comparison is drawn between the various methods of making prints from tracings. Although the process is a positive one at present, in certain cases it is possible to obtain negative prints. The author deals mainly with diazo-sensitised paper suitable for printing from tracings, although one or two applications and development methods for printing from photographic negatives are given. In the *Discussion*, **Clark** emphasised the fact that true-to-scale reproductions were obtainable by this method, which was likely to rival blue prints. The speed of the sensitive material was of the same order as that for a modern highly sensitive plate, and also extended into the red. There was no reason why the process could not rival the usual silver processes, but further development was necessary. R. C. F.

1168. Influence of Photographic Reactions on the Weigert Effect in Photochlorides. H. Zocher and K. Coper. *Zeits. f. phys. Chem.* 139. *pp.* 263–272, *Dec.*, 1928.

The anisotropy produced by the Weigert effect in photochlorides [see Abstract 1889 (1928)] persists in all the photographic reactions now investigated. T. M. L.

1169. Polarisation of Light Emitted by Fluorescence. P. Soleillet. *Comptes Rendus*, 187. *pp.* 976–978, *Nov.* 26, 1928

It is pointed out that nine parameters are applicable to the case of emission, and nine corresponding ones to the case of excitation. In the general case there are thus 81 constants to be determined. This reduces to 19 for a symmetrical magnetic field, to 10 for a symmetrical electrical field, and to 3 for the case of isotropy. To determine these last constants it is necessary to excite with circularly polarised light and to make two observations. This has been done for the resonance lines of thallium. F. S.

1170. Polarisation of Light Emitted by Fluorescence. P. Soleillet. *Comptes Rendus*, 187. *pp.* 1136–1138, *Dec.* 10, 1928.

In this continuation of previous work [see preceding Abstract], cases are considered in which normal polarisation is diminished by collision with molecules of another gas, brownian movement of rotation, or Larmor rotation due to a magnetic field. For the isotropic case it is only found necessary to introduce the means of $\cos^2 \alpha$, and $\cos \alpha$, α being the angle made by a vibrating element and its normal position. The case of depolarisation by secondary resonance is also considered. F. S.

1171. Deterioration of Quartz Mercury-Vapour Lamps, and the Luminescence of Transparent Fused Quartz. A. E. Gillam and R. A. Morton. *Phil. Mag.* 6. *pp.* 1123–1132, *Dec.*, 1928.

Investigates the ageing of quartz mercury-vapour lamps, and shows that there are two visible signs of such ageing—a brownish-black deposit on the interior surface (most noticeable in the thick constriction), and internal fractures of the thick quartz at the constriction, with globules of mercury embedded below the surface. The black deposit is very adherent and resists the action of strong acids. The deterioration of quartz mercury-vapour lamps is due to a shortening of the extreme ultra-violet part of the spectrum, and a non-selective transmission loss. The first factor predominates for the first 150–200 hours, when there is a rapid fall in output. After this period it becomes fairly constant, and the second factor plays an increasingly important part. The shortening of the spectrum is possibly due to the formation of silicon monoxide vapour, whilst a gradual deposition of a film of opaque silicon might account for the transmission loss. There is little or no connection between the deterioration and the luminescent properties of fused quartz, after illumination with ultra-violet radiation. Transparent fused quartz, after such illumination, exhibits three types of luminescence: a brief visible phosphorescence; a long phosphorescence; and a thermoluminescence. Samples of fused silica which exhibit this property apparently contain traces of impurity. R. C. F.

1172. First Spark Spectrum of Gold (AuII). J. C. McLennan and A. B. McLay. *Roy. Soc. Canada, Trans.* 22. *Sect.* 3. *pp.* 103–115, *Jan.*, 1928.

A term scheme is put forward for AuII, similar to the term schemes for CuII and AgII. The ground-term, according to the authors, is a $^{1}S_{0}$ term, but it lies too low for the apparatus used (fluorite spectrograph for the low wave-lengths). The numbers given are based on the lowest found, $^{3}D_{3}$, as zero. Comparison of the $^{3,1}D$ ($d^{9}s$) and $^{3,1}D$ (d^{9}, s) intervals show the convergence of the $^{3}D_{3}$ and $^{3}D_{2}$ series to $^{2}D_{3}$ (d^{9}) and of the $^{3}D_{1}$ and $^{1}D_{2}$ series to $^{2}D_{2}$ (d^{9}) of AuIII, which is at variance with the simple Huad theory. All the terms are inverted, but the $^{3}\overline{F}$ and $^{3}\overline{D}$ terms are partly re-inverted. Ten of the components of the pentad $^{3,1}G, \overline{F}, D, \overline{P}, S$ ($d^{9}d$) have been located. In addition, a number of sharp lines can be accounted for by means of five metastable terms that combine with terms of the $d^{9}p$ triad. These probably belong to a group ^{3}F, ^{3}P, ^{1}G, ^{1}D, ^{1}S ($d^{8}s^{2}$). A. C. M.

1173. Ultra-Violet Spectra of the Spark in Liquids. A. Campetti. *N. Cimento*, 5. *pp.* 291–306, *Aug.–Sept.–Oct.*, 1928.

Ultra-violet spectra of the spark in water, vaseline and tetrachloride of carbon. The continuous background (which is particularly intense when there is no inductance in the circuit) is especially due to the central zone of the spark. The number of inverted rays increases towards the shorter wave-lengths; but it is affected by the nature of the liquid, the electrical conditions of the circuit, etc. Those rays which are most easily inverted seem due to neutral atoms. As a general rule, those rays are strongly inverted which correspond to the first and second potentials of resonance of the element. The isolated line 4226·73 of magnesium seems to be due, not to a neutral atom of magnesium, but to a group containing hydrogen, and the line 4057·97 of lead to a group containing oxygen. A. D.

1174. Emission and Absorption of Light. J. Stark. *Ann. d. Physik*, 87. 7. *pp.* 909–926, *Dec.* 8, 1928.

This is a non-mathematical application of the recent theory, in which a train of waves is associated with each moving electron, to a number of cases of emission and absorption of light. In the case of canal rays, the moving electron is considered in relation to the positively charged atom-ion. The time of emission of lines such as $H\gamma$ is discussed, and also the change of frequency in an electric field in relation to the experiments of Rausch von Traubenberg and Gebauer. In the case of excitation by kathode rays, in addition to the moving electron and the positive atom-ion, there is the excited electron. A continuous spectrum in the infra-red is predicted and also a continuous spectrum, such as is observed in hydrogen, when the energy of the rays is less than the difference between the lowest level and the next higher for the farthest electron. Continuous X-ray spectrum is also discussed. Among the cases of absorption discussed are selective absorption, fluorescence and the Raman effect, and photoelectric absorption. F. S.

1175. Axiality of Light Emission and Related Problems. E. Rupp. *Phys. Zeits.* 29. *pp.* 625–626, *Sept.* 1, 1928.

In a recent paper [see Abstract 2997 (1928)] by Hirsch and Döpel, comments were made on the author's experiments on the polarisation of light from positive rays. He here replies, and amplifies his original statement, and gives a table to show the corrections made for polarisation due to the apparatus itself. A. C. M.

1176. Axiality of Light Emission and Related Problems. R. v. Hirsch. *Phys. Zeits.* 29. *pp.* 730–731, *Oct.* 15, 1928.

Reply to the remarks by Rupp [see preceding Abstract] on the previous paper by Hirsch and Döpel [see Abstract 2997 (1928)].

1177. Anomalous Dispersion of Hg and Li. E. Segrè and E. Amaldi. *Accad. Lincei, Atti,* 7. *pp.* 919–921, *June* 1, 1928.

An inquiry into the intensity of various absorption lines: in particular the relation between the intensities of the lithium lines 2S–2P (6708 Å.) and 2S–3P (3232 Å.), and the mercury lines 6^1S_0–6^1P_1 (2537 Å.) and 6^1S_0–6^1P_1 (1849 Å.). A. D

1178. Width of Hg Spectrum Lines. A. Carrelli. *Accad. Lincei, Atti,* 7. *pp.* 1014–1018, *June* 17, 1928.

A detailed paper on the width of various mercury lines. The treatment is quantic. The widths range from 0·0013 Å. to 0·05 Å. A. D.

1179. Ultimate Rays in Spectral Series. A. T. Williams. *Univ. Nac. La Plata, Estudio Ciencias, No.* 86. *pp.* 361–396, *Nov.,* 1928. *In Spanish.*

The examination of the persistence of the lines at the beginning of the Schumann region shows the anomaly presented by Hg, the principal ultimate line of which is an intercombination line (2536·52, 1^1S^3P) and not the line 1859·57, $^1S^1P$. Besides, the persistence is established of the lines of Al** and it is found that 1862·90 and 1854·67, belonging to the series $^2S^2P$, are ultimate rays. Megger's rule applies to 60 % of the ultimate rays at present known and classified; there are very few exceptions to Croze's rule. To the ultimate ray doublets of the neutral atoms ($^2S^2P$) of the elements of the first column correspond, as ultimate rays, the doublets of the simply and doubly ionised atoms of the second and third columns respectively. In the fourth column Si offers among its ultimate rays doublets of the simply ionised atom. The ultimate rays of the elements of the first and second columns, and part of those of the third, are due to combinations between terms whose numbers l are 0, 1, or 2. For the remaining elements the terms have $l = 2$, 3 or 4. The ultimate rays arise from those transitions in which only a single electron orbit changes while the remainder of the configuration remains unaltered, with the exception pointed out by Russell for Ti and by the author for Ba, which have ultimate rays originated by a double electron jump. The ultimate lines are tabulated. A. D.

1180. Spectra of Mercury Above the Ionisation Potential. L. R. Maxwell. *Phys. Rev.* 32. *pp.* 715–720, *Nov.,* 1928.

Electrons in mercury vapour with velocities greater than the ionisation potential were confined into a beam by a magnetic field. The light produced was projected on the slit of a spectroscope with the direction of the beam at right angles to the slit. Perpendicular to the beam an electric field withdrew positive ions before they recombined. The intensity of the arc lines was found to be independent of the electric field, which indicates that recombination contributes very little to the formation of these lines. These results are contrary to the previously accepted explanation given for the complete arc spectrum appearing above the ionisation potential. Consequently, in addition to simple excitation, the arc spectrum can be explained in the two following ways: (1) as being due to the return to the 1^1S_0 state by an electron which has been displaced from an inner energy level to a virtual orbit while simultaneously one of the electrons of the valency group falls in to fill the vacated level; (2) due to a special type of recombination which is called initial recombination. Spark lines due to singly and doubly charged ions show a variation of intensity along their length in such a manner that it is possible to distinguish them from the arc lines. It is also possible to differentiate between the lines of the first and the second spark spectrum. AUTHOR.

1181. Determination of the Mean Life for the 4797 Å. Spark Line of Doubly Ionised Mercury. L. R. Maxwell. *Phys. Rev.* **32.** *pp.* **721–726,** *Nov.,* **1928.**

With the method illustrated by the writer in the previous paper [see preceding Abstract], the spark line 4797 Å. due to ions moving in a particular direction through a beam of electrons was obtained showing a peculiar variation of intensity. Calculations are made to determine how the intensity of the line should vary with respect to its position across the beam and for different current densities of the beam. Cases are worked out for both uniform and non-uniform electron current densities of the beam. On comparison with the experimental results, it can be shown that the line is produced at a single electron impact, and that the average life of the excited state is 4×10^{-7} second. Although the mean life for the first order spark lines could not be measured, it is estimated that it is less than 1×10^{-7} second. AUTHOR.

1182. Fine Structure of the Sharp Series Triplet, $2^3P_{0,1,2} - 2^3S_1$, of Optically Excited Mercury Radiation. E. H. Collins. *Phys. Rev.* 32. *pp.* 753–760, *Nov.,* 1928.

Measurements on the fine structure of the sharp series triplet, lines of wave-lengths λλ5461, 4358 and 4047 were made with two Lummer-Gehrcke plates under two conditions of optical excitation. The first condition of optical excitation was obtained by having mercury vapour only in the resonance tube, giving excitation by absorption of λ4358, the second by having mercury vapour with nitrogen present at a pressure of 2 to 4 mm., giving excitation by absorption of both λ4358 and λ4047. For the first condition of excitation the wave-length differences in milli-Ångströms are for λ5461, $d\lambda 0$; for λ4358, $d\lambda - 157, - 107, - 20, 0, + 30, + 46, + 183$; for λ4047, $d\lambda - 116, - 62, - 52, 0$. For the second condition the wave-length differences are for λ5461, $d\lambda - 235, 0$; for λ4358, $d\lambda - 107, - 20, 0, + 30, + 183$; for λ4047, $d\lambda - 110, - 62, - 53, 0$. Certain fine structure energy differences of interest in the construction of energy diagrams are pointed out, but it was not found possible with the data available to construct a complete energy diagram of the triplet. A comparison of the fine structure observed under the two conditions of optical excitation with one another and with the fine structure of the arc shows striking differences, which make it evident that differences in fine structure exist which depend on the method of excitation. AUTHOR.

1183. Continuous Spectrum of Mercury. J. K. Robertson, K. A. MacKinnon, W. H. Zinn. *J.O.S.A. and R.S.I.* 17. *pp.* 417–427, *Dec.,* **1928.**

The continuous band spectrum of mercury vapour was observed

(1) when a drop of mercury was kept rolling in a heated cylindrical quartz tube by means of a horizontal to-and-fro motion of the tube; (2) when the same tube in an electric oven was excited to luminosity by a high-frequency electrodeless discharge. By the electrodeless method, with temperatures ranging from 160° C. to over 200° C., and a controlling spark gap of the order of 1 cm., conditions were favourable for the continuous emission, while a greater temperature range was permissible in the first method. In each case the three well-known continuous bands with maximum intensities in the neighbourhood of 4600, 3300, 2536, were observed, while, in addition, on one or two plates taken by the second method, a fourth band with the maximum at about 2650 was obtained. No evidence was found of the two continuous spectra observed by Balasse and ascribed by him to recombination—in the one case of the doubly ionised, in the other of the singly ionised atom. A discussion of the origin of the continuous spectrum considers the relative merits of a recombination theory in which the atom is the ultimate source, and one according to which radiation is from excited molecules. The authors conclude that the evidence is all in favour of the latter. E. E. F. d'A.

1184. Power Relation of Intensities of Lines in the Optical Excitation of Mercury. Theories I and II. E. Gaviola. *Phil. Mag.* 6. *pp.* 1154–1191, *Dec.*, 1928.

The intensity of mercury lines excited in vapour by a water-cooled mercury arc is calculated as a function of primary intensities and the position of the emitting volume element. The special behaviour of λ3650 is considered and the absorption laws of λλ4358 and 3650. The admixture of foreign gases is also considered and λ4046 has been studied experimentally. The number of metastable mercury atoms is increased one-hundred fold by admixture of a few milligrammes of nitrogen or water vapour. In the absence of foreign gas the mean life of the higher metastable level 2^3P_2 is found to be of the order of 18^{-5} second, and the lower metastable lever 2^3P_0 about one three-hundredth of a second. F. S.

1185. Quenching of Mercury Resonance Radiation and its Relation to Reactions Sensitised by Excited Mercury Atoms. A. C. G. Mitchell. *Frank. Inst., J.* 206. *pp.* 817–825, *Dec.*, 1928.

Zemansky's theory of the quenching of resonance radiation [see Abstract 2378 (1928)] is discussed and contrary conclusions arrived at. With regard to activational processes of sensitised reactions, it is pointed out that these probably occur in the gas phase. The high quenching efficiency of O_2 for mercury resonance radiation is accounted for by assuming that O_2 can take up energy of oscillation by collision of the second kind with excited mercury atoms. F. S.

1186. Band Spectroscopy and Flame Processes. K. F. Bonhoeffer and F. Haber. *Zeits. f. phys. Chem.* 137. 1–4. *pp.* 263–288, *Oct.*, 1928.

The presence of the band of wave-length 3064 Å. in the spectrum of the hydrogen flame shows that such flame contains the hydroxyl radicle, and the same band occurs in absorption when a mixture of oxygen, hydrogen and water vapour is heated to high temperatures. The energy of formation of hydroxyl from its atoms and those of water vapour and hydrogen-peroxide vapour from hydroxyl are calculated, and the significance of hydroxyl in the explanation of flame phenomena is discussed.

The carbon monoxide flame, the Swan spectrum, the ultra-red spectrum of the saturated hydrocarbons, the spectrum of burning hydrocarbons, and the connection between conduction and luminescence are also considered. T. H. P.

1187. "Forbidden" Hydrogen Lines. A. Rubinowicz. *Phys. Zeits.* 29. *pp.* 817–823, *Nov.* 15, 1928.

The work of Bowen [see Abstract 1165 (1928)], showing that the so-called nebulium mist lines correspond to forbidden transitions from metastable initial states, forms a convincing experimental support for the conception that the choice-rule of the quantum theory only holds in general to a first approximation. In the present paper the forbidden transitions are investigated for the simplest case of the Hyman-hydrogen series, the Schrödinger theorems for the current and charge density being utilised together with the conception of retarded potential. § 1 considers the electromagnetic field of the hydrogen atom taking into account the retarded potential. § 2 deals with energy and impulse moment radiation. § 3 investigates the conservation of energy and the impulse moment during radiation. § 4 examines the intensities of the "forbidden" Hyman lines. The paper is entirely mathematical. H. H. Ho.

1188. Determination of the Wave-Length of the Kα Line of Carbon. B. B. Weatherby. *Phys. Rev.* 32. *pp.* 707–711, *Nov.*, 1928.

A simplified type of vacuum spectrometer utilising a plane glass grating with 250 lines per mm. was used to measure the wave-length of the Kα line of carbon. A water-cooled metal X-ray tube with tungsten kathode was connected directly with the spectrometer without the interposition of any absorbing screen in the X-ray beam. The measurements were made under varying conditions. The angle of incidence being varied from 20 ft. to 50 ft. and the distance from the grating to the plate from 50 to 80 cm. A weighted mean of all determinations gives the wave-length of the Kα line of carbon as 45·4 Å. AUTHOR.

1189. Spark Spectrum of Sulphur, SII, in the Schumann Region. P. Lacroute. *Comptes Rendus*, 187. *pp.* 975–976, *Nov.* 26, 1928.

Some multiplets have been identified among the lines recently published [see Abstract 3220 (1928)]. A number of lines are included which did not appear in the previous tables. F. S.

1190. Ionisation Potential of the Tin Atom. R. G. Loyarte. *Univ. Nac. La Plata, Estudio Ciencias, No.* 86. *pp.* 409–413, *Nov.*, 1928.

By the method of electronic impacts the author finds a critical potential at 7·39 for the atom of tin, which he considers to be the ionisation potential according to the series established in the arc spectra by Green and Loring [see Abstract 641 (1928)]. They find 7·37 ± 0·05, which is very closely in accordance with the potential found by the electrical method.

AUTHOR.

1191. Grimm's Law and the Ionisation Potential of the Water-Molecule. R. Grinfeld. *Univ. Nac. La Plata, Estudio Ciencias, No.* 86. *pp.* 415–426, *Nov.*, 1928. *In Spanish.*

The law of Grimm is fully confirmed by the series of pseudo-atoms of Ne, with the following new values of ionisation potentials: 14·6 for

CH_4 and 18 for H_2O. There is a linear relation between molecular refraction and ionisation potential for Ne, H_2O and CH_4. By interpolation the probable value of the ionisation potential of NH_3 is approximately 16 volts. By Lenard's method the resonance potential of the water molecule is 6·2 volts. There is, also, a very pronounced excitation potential at 13·2 volts; Mackay believed this to be the ionisation potential of the water molecule, but the author does not agree. A. D.

1192. Ionising Potentials and Far Ultra-Violet Lines of Light Atoms. L. A. Turner. *Phys. Rev.* 32. *pp.* 727–736, *Nov.*, 1928.

By an interpolation the ionising potentials of F and F^+ are found to be 17·4 and 34·5 volts. These new values improve the regularity of the relationships of the values of $(\nu/R)^{1/2}$ corresponding to the ionising potentials of the atoms of the first short period. The energy necessary for the removal of a 2*s* electron from each of many of the atoms and ions of these elements (L_{11} levels for an atom) is calculated by the use of the $s^2p^{n-1} - sp^n$ lines. The effect of the removal of a 2*s* electron upon the subsequent removal of a 2*p* electron is found for B, F and Ne to be an increase of $(\nu/R)^{1/2}$ by about 0·45. This is used to get a prediction of the wave-lengths of missing $s^2p^{n-1} - sp^n$ lines of C, N, N^+ and O. New identifications of the far ultra-violet lines of Mg are proposed, and the third ionising potential is found to be 80·4 ± 1 volts. A pair of lines of F are tentatively identified as the $2s^22p^5\,{}^2P - 2s2p^6\,{}^2S$ lines. AUTHOR.

1193. Spectra of Doubly Ionised Arsenic, Antimony and Bismuth (AsIII, SbIII, BiIII). R. J. Lang. *Phys. Rev.* 32. *pp.* 737–745, *Nov.*, 1928.

The spectra of the elements AsIII, SbIII and BiIII have been partially analysed by the use of the irregular doublet law and the Moseley law and the published data for the two preceding elements of each iso-electronic sequence. In AsIII and BiIII the important terms from the configurations ns^2np, ns^2nd, $ns^2(n+1)s$ have been located and, with the exception of the quartet P terms, those from the $nsnp^2$ configuration. (n is equal to 4 for AsIII, 5 for SbIII and 6 for BiIII.) In AsIII alone the ${}^2P$ term of the np^3 configuration was found. The terms of SbIII located consist of some of those for the first three configurations only. AUTHOR.

1194. Temperature Classification of the Stronger Lines of Cerium and Praseodymium. A. S. King. *Mt. Wilson Observat. Contrib. No.* 368. *Astrophys. J.* 68. *pp.* 194–245, *Oct.*, 1928.

Lines occurring in the vacuum furnace spectra at various temperatures have been measured with a 15-ft. concave-grating spectrograph. Special spectrograms of iron mixed with the raw-earth compound were taken for the measurement of wave-lengths. These lines, together with those in available tables, are listed and classified, there being 1362 for cerium and 1018 for praseodymium. Special attention is given to the distinction between lines of the neutral and ionised spectra. Nearly 40 % of the praseodymium lines listed are highly complex, and attention is now to be given to their fine structure. F. S.

1195. Fine Structure of the D_3-Line of Helium. H. R. Wei. *Astrophys. J.* 68. *pp.* 246–256, *Oct.*, 1928.

This line has been resolved into a triplet in the sixth order of a 10-in. grating mounted in a 30-ft. Littrow spectrograph. Analysis of the spectrogram with a microphotometer gives a ratio of intensity of 4·5 : 3 : 1 and a ratio of separation of 10·3 : 1, in good agreement with Burger's prediction [see Abstract 367 (1927)]. The result has been verified by means of a thirty-plate echelon grating. A new type of discharge tube cooled in liquid air is described, which eliminates absorption, Stark effect and self-reversal. A method of determining relative intensities of unresolved or partially resolved components for a special case has been worked out. F. S.

1196. Energy Relations in the Helium Spectrum. I. C. Cornog. *Phys. Rev.* 32. *pp.* 746–752, *Nov.*, 1928.

Photographs of the helium spectrum produced in an equipotential space using an equipotential kathode have been studied photometrically in order to determine the variation of line intensities on passing the various critical potentials. The results cover the 54·2-volt point, at which double ionisation is first possible. Spectra were taken at suitable values between 50 and 60 volts, often at intervals of 0·1 volt. The plates show a marked maximum of intensity near 54·2 volts for all the lines measured.

AUTHOR.

1197. Intensity Measurements in the Helium Spectrum. C. Hodges and W. C. Michels. *Phys. Rev.* 32. *pp.* 913–917, *Dec.*, 1928.

The absolute and relative intensities of thirteen lines of the helium spectrum, extending through the visible region, have been measured by a modification of the method developed by Ornstein and Dorgelo. The change of the method has consisted in comparing each line directly with the known emission from a tungsten filament, operated under constant conditions. The results for a discharge in a capillary tube, with pressures from 1·92 to 34·3 mm., show that the absolute intensities increase rapidly to a maximum for pressures in the neighbourhood of 2 to 4 mm., below which they tend towards zero. The relative intensities of the singlet system are favoured by lowered pressures, and the higher members of the triplet system are likewise favoured over the lower members, while the relative intensities within the singlet series show little effect of pressure.

AUTHORS.

1198. Near Infra-Red Vibration Spectrum of the Carbonates. H. H. Nielsen. *Phys. Rev.* 32. *pp.* 773–778, *Nov.*, 1928.

An attempt has been made to solve theoretically the problem of the frequencies and intensities of the near infra-red absorption regions of the carbonate group. The assumption, that in the normal state the oxygen nuclei are located at the vertices of an equilateral triangle while the carbon nucleus lies at the centre, seems justified by the X-ray investigations of the crystal structure of the group. Using a general potential energy function with three constants under the assumption that the fields of force surrounding the nuclei are central, the normal modes of infinitesimal vibration are determined, yielding four independent frequencies ν_1, ν_2, ν_3 and ν_4, of which ν_4 is optically inactive. Through the three disposable constants, ν_1, ν_2 and ν_3 may be made to coincide with the three fundamental absorption regions found experimentally by Schaefer and Schubert, and it is found that the optically inactive frequency ν_4 agrees closely with the value predicted by Schaefer, Bermuth and Matossi. From a consideration of the change of electric moment, the theoretical intensities are determined. It is found that the relative intensities obtained theoretically agree well with the values determined by Schaefer and Schubert. AUTHOR.

1199. Infra-Red Absorption Spectra of Organic Carbonates. F. K. Bell. *Am. Chem. Soc., J.* 50. *pp.* 2940–2950, *Nov.*, 1928.

The absorption spectra of dimethyl, diethyl, dipropyl, dibutyl, di-isobutyl, di-isoamyl and diphenyl carbonates, measured between 1·0 and 12·0 μ, with the help of absorption cells of polished rock-salt plates, show marked similarity in the number and location of absorption bands between 3·0 and 8·0 μ, but no consistent variations or similarities in the region between 8·0 and 12·0 μ. Difficulties arise when an attempt is made to apply the method of analysis used by Schaefer, Bormuth and Matossi [see Abstract 1033 (1927)] for the absorption spectra of the inorganic carbonates to the curves now obtained. The relatively inactive metallic ions of the inorganic carbonates have been replaced by hydrocarbon radicles which are known to display characteristic absorption between 2 μ and 9 μ, the intensity of these hydrocarbon bands being relatively much greater than those of the carbonate ion. Moreover, a number of the characteristic carbonate bands are located near or superpose characteristic C-H bands, for example, 3·5 μ, 7 μ and 14 μ, so that both the location and the intensity of the bands of the organic carbonates are to be interpreted with caution. Increase in the intensity of the 3·4 μ band with increase in the molecular weight of the ester radical is observed, but the intensity values of this band in the spectra of di-isobutyl and di-isoamyl carbonates are not satisfactorily accounted for by the relations derived by Henri (*Études de Photochimie*, p. 42, 1919) or Bonino (*Gazzetta Chimica Italiana*, 55. *p.* 335, 1925). The intensity relations of the 5·75 μ band in the spectra of the various organic carbonates offer a grave objection to the view that this band depends solely on the presence of the carbonate group. Analysis of the variations in intensity of characteristic absorption bands in the various organic carbonates indicates that the normal and the iso-esters may be regarded as belonging to two distinct types of carbonates. T. H. P.

1200. Nature of Active Nitrogen. H. O. Kneser. *Ann. d. Physik*, 87. 5. *pp.* 717–736, *Nov.* 1, 1928.

The measurements made were of the decay of the afterglow of active nitrogen, with different pressures of nitrogen, various amounts of added rare gas (argon), and for different conditions of the walls of the enclosing vessel. Good agreement was obtained with the rate of decay computed on the basis of the atomic view which regards the deactivisation as due to triple collisions between two nitrogen atoms and an inactive particle. The results are definitely inconsistent with the molecular view, although probably they could be explained in terms of the combined theory of Corio and Kaplan. W. S. S.

1201. Ultra-Violet Band Spectrum of Nitrogen. R. T. Birge and J. J. Hopfield. *Astrophys. J.* 68. *pp.* 257–278, *Nov.*, 1928.

The ultra-violet emission spectrum of N_2 consists chiefly of a clearly defined system of more than sixty bands, degraded to the red. Spectrograms of this system have been obtained with a vacuum spectrograph, and the weighted average wave-length of each band is tabulated, together with the vibrational quantum analysis of the system. The absorption spectrum of N_2 also contains this system, and the absorption measurements have been used to determine most accurately the vibrational constants of the upper level. Numerous emission and absorption bands occur in addition to the foregoing system. Among the emission bands can be recognised three distinct progressions, representing presumably three new systems. The analysis of each of the three systems indicates that it is due to a transition from a new upper level to the vibrational states of the normal electronic level of the molecule. One of these systems occurs, however, when commercial, partially purified nitrogen is used, but not with chemically prepared nitrogen, and its origin is therefore in doubt. The intensity distribution in all four nitrogen systems presents several interesting features, some of which have not been explained. Further study is being made of the many remaining unassigned bands, in emission and in absorption. From the vibrational constants of the several electronic levels one can calculate approximately the heat of dissociation of N_2. Two possible alternatives lead to most probable values of 11·9 and 9·5 volts, respectively. AUTHORS.

1202. Absorption Spectra of Liquids. P. Bovis. *Rev. d'Optique,* 7. *pp.* 434–449, *Nov.*, 1928.

The author first discusses the present state of our knowledge of absorption spectra of liquids. Two sections are considered: structure of the spectra, and factors which produce alterations in them. In the first section it is shown that the absorption spectra can generally be divided into two different classes of large continuous bands, whilst in the second the distribution of the bands in the spectrum, their length and intensity are dealt with. Further, the effect of the change of temperature, alteration of the solvent, and the age of the solution are considered. Finally, results are given for various solutions which have been obtained over a period of almost four years. It is shown that age has no apparent effect on a dilute copper-sulphate solution, such solution also having the advantage of being in agreement with Beer's law. Decinormal solutions of cobalt sulphate and cobalt chloride undergo a slight change of absorption with time, whilst solutions of nickel sulphate, nickel chloride and potassium chromate of the same strength are unaffected. Measurements made on very dilute solutions of potassium chromate show that they approximately follow Beer's law. R. C. F.

1203. Aurora Red Line. J. Kaplan. *Nat. Acad. Sci., Proc.* 14. *pp.* 882–884, *Nov.*, 1928.

The suggestion that a red line at 6654·8 Å.U. observed by the author in experiments on active nitrogen mixed with oxygen is due to oxygen is now shown to be probably incorrect, the "line" corresponding to a band belonging to the first positive group of nitrogen. W. S. S.

1204. Structure of the Ground Line and Some Other Lines of the Cadmium Spectrum. Annelise Schrammen. *Ann. d. Physik,* 87. 5. *pp.* 638–652, *Nov.* 1, 1928.

The structure of the cadmium line $1'S_0 - 2'P_1$ measured by Wood [see Abstract 121 (1927)] is shown to be changed round, as a result of self-reversal. Investigations of the line in emission and absorption indicate a non-separated satellite distant $d\lambda = -0\cdot35 . 10^{-3}$ Å.U. from the principal line. The structures of other cadmium lines and of the mercury line $\lambda = 2537$ (*five* components found by Wood confirmed) are also given. **Errata,** 87. 7. p. 964, Dec. 8, 1928. W. S. S.

1205. Spectrum of Ionised Argon (ArII). T. L. de Bruin. *K. Akad. Amsterdam, Proc.* 31. 7. *pp.* 771–779, 1928.

Portions of this paper are contained in an earlier one by the author [see Abstract 488 (1929)]; in addition a table is given of the energy levels, showing the different electronic configurations, the symbols for these and the corresponding terms, quartet and doublet, under the basic term ^3P, doublet under the basic term ^1D and doublet under the basic term ^1S; there is also a term table giving the symbols of the experimental and corresponding theoretical terms, with the term values. The spectrum is compared with those of some other atomic configurations, including ClII, KII, CaII and ScII; the ionisation potentials of these are (25), 31·68, 11·81 and 12·84 volts, that of ArII, which comes between ClII and KII, is 27·25 volts. A table gives the energy values of the 4*s* terms of these atomic configurations, the effective quantum numbers, which decrease from 2·28 for ClII to 2·07 for ScII, and the quantum defects. A short theoretical explanation of these relations is given. H. N. A.

1206. Absorption Spectra of Negative Halogens Ions in Aqueous Solutions. J. Franck and G. Scheibe. *Zeits. f. phys. Chem.* 139. *pp.* 22–31, *Dec.*, 1928.

The outer shell of the negative halogen ion resembles that of the inert gases, but the forces between the excess electron and the neutral atom decrease more rapidly in the former. Discrete excitation levels of the negative ions, if at all existent, should therefore correspond to a loose binding and occur in the range near the long-wave boundary of the continuous spectrum, where their distinction from molecular spectra would be difficult in the case of gases. With solid halogens the affinity spectrum should lie in the ultra-violet near 1500° Å. But Scheibe's experiments show that the absorption spectra of alkali iodide and bromide solutions in water, in the less extreme ultra-violet, can be ascribed to negative halogen ions. The spectrum of the iodine ion has there two maxima, about 8000 wave numbers apart. That frequency difference is in fair agreement with electron affinity values $h\nu = E + H + P - S - S_1$, where E is the affinity of the gaseous ion, H the energy of hydrating the negative ion, P the mutual potential energy of the water dipole, and the S are the heats of solution of the iodine atom and electron. This view does not appear to be in accord with the photochemical observation of Warburg and Rump [Abstract 1410 (1928)] that hydrogen iodide dissolved in hexane (in which it is not dissociated) follows Einstein's equivalence law, as does the gaseous HI, whilst the solution in water (dissociated) does not. An explanation of the apparent discrepancy is suggested. H. B.

1207. Red Band System of Sodium. F. W. Loomis and S. W. Nile, Jr. *Phys. Rev.* 32. *pp.* 873–879, *Dec.*, 1928.

The occurrence of an infra-red edge to the red band system of Na_2 is reported and is explained in terms of the Franck-Condon theory of intensity distribution when account is taken of the shape of the potential energy curves as dissociation is approached. The same theory explains a head of the red system in the yellow-green, the reappearance of the orange "kathode-ray fluorescence" series in the infra-red, and the observed asymmetry in the two branches of the Condon "parabola." AUTHORS.

1208. Infra-Red Absorption Spectra of Methyl Halides. W. H. Bennett and C. F. Meyer. *Phys. Rev.* 32. *pp.* 888–905, *Dec.*, 1928.

The molecules are symmetrical tops having one low moment of inertia. Two types of bands are expected, one arising from vibration parallel to the axis of symmetry, ‖ bands, and the other from vibration perpendicular to the axis of symmetry, ⊥ bands; the appearance of each type is described. There are seven bands for each of the four compounds. The twenty-eight bands fall into seven series, A to G inclusive. Two of the four bands of series A lie beyond the range of observation. Series A, C, E and F are made up of bands of the ‖ type, and series B, D and G, of bands of the ⊥ type. The series converge towards the known bands of methane with decrease in the atomic weight of the halogen in the halide. The envelopes of the bands of the ‖ type demonstrate the existence of P, Q and R branches. The doublet separations for the various bands of the same compound appear to be the same; the chloride may, however, present an exception to this rule. In passing from compound to compound, the doublet separations increase with decrease in the atomic weight of the halogen in the halide. The band of series A for methyl fluoride has been resolved, and it is revealed that the P and R branches consist of a single series of lines. Strong convergence in the spacing is present. The bands of the ⊥ type have all been resolved. Every third line is more intense than the others. The spacing converges in series B towards lower frequencies, and in series D and G towards higher frequencies. The mean frequency intervals from band to band of the same compound are found to vary markedly. The explanation of this variation presents a theoretical problem of interest.
AUTHORS.

1209. Visible Absorption Bands of Colourless Liquids and Their Relation to Infra-Red Bands. J. W. Ellis. *Phys. Rev.* 32. *pp.* 906–912, *Dec.*, 1928.

The absorption of ten representative organic liquids has been studied in the visible spectrum by photographic means. Cell lengths up to 6½ metres were employed. The near infra-red spectra of these same substances have been obtained. A good correlation of the bands of the two regions has been secured; the bands of the visible region seem to be higher members of series previously detected in the infra-red. AUTHOR.

1210. Intensity Relations in Spectra of Titanium. Part. I. Line Intensities in the Stronger Multiplets of TiI and TiII. G. R. Harrison. *J.O.S.A. and R.S.I.* 17. *pp.* 389–416, *Dec.*, 1928.

The relative intensities of the lines in twenty-six of the stronger multiplets of the spectrum of normal titanium, TiI, and in eight of the stronger multiplets due to the singly ionised atom, TiII, were measured by a general method of photographic photometry which is described in detail. In TiI, 58 % of the multiplets were found to obey the intensity formulæ to well within 5 %, while in the 42 % of abnormal multiplets, 71 % of the lines were found normal, with 16 % abnormally weak and 13 % abnormally strong. In TiII, 62 % of the multiplets measured were normal, while of the abnormal 38 %, 61 % of the lines were normal, with 21 % abnormally weak and 18 % abnormally strong. Of all the lines measured, 86 % appeared normal in intensity, while 7·6 % were too weak and 6·4 % were too strong. The departures from the predicted intensities are often fairly large, generally being of the order of 10 % to 40 %. No definite correlation was found between intensity abnormalities and departures from Lande's interval rule or the normal Zeeman patterns. AUTHOR.

1211. Reversals in the Arc-Spectrum of Nickel. A. C. Menzies. *Phil. Mag.* 6. *pp.* 1210–1216, *Dec.*, 1928.

Empirically the ground-term of NiI is a term $^3F_4$, although a $^1S_0$ term might be expected. The method of obtaining spectra by fusing wires in air previously developed [see Abstract 2712 (1928)] has been used in the ultra-violet and Schumann regions and a table of the reversed lines observed is given. Most reversals in the ultra-violet can be accounted for by transitions to known low levels, while all long lines in the Schumann region appear to belong to ground-terms $^2D_3$ and $^2D_2$ of NiII. If a $^1S_0$ term exist, it must give rise to lines below the region examined. F. S.

1212. Influence of Pressure and Addition of Other Gases on Absorption in Excited Neon. L. Eckstein. *Ann. d. Physik*, 87. 8. *pp.* 1003–1034, *Dec.* 18, 1928.

The light from an emission tube containing pure neon was passed through the absorption tube containing neon at different pressures with or without the addition of other gases. The intensity of the light transmitted was determined (after spectral decomposition), using a photoelectric cell. The absorption tube was separately excited and the lines worked with were certain red lines proceeding from the metastable s_3 and s_5 terms. The curves relating absorption with gas pressure using pure neon showed a maximum at a pressure of 1·2 mm. Hg. Addition of helium in increasing quantity caused a slow decrease in the absorption; hydrogen, nitrogen and argon showed the same effect but in essentially higher degree (about 1000 times). This difference of behaviour is attributed to the fact that the first excitation energy of the latter gases is less than that of the s_3 and s_5 neon states, whereas the first excitation energy of helium is greater. W. S. S.

1213. Increase of Energy in Elementary Processes. H. Beutler and B. Josephy. *Zeits. f. phys. Chem.* 139. *pp.* 482–496, *Dec.*, 1928.

The fluorescence and chemical luminescence in rarefied gases is shown to take place as a result of excited particles in collision. Under certain conditions it is possible to observe the collision of two excited atoms, whereby one returns to its original state, and the other takes up the total energy. The metastable mercury atoms which were excited by light in the presence of nitrogen, or rarefied gases produced by chemical reactions, are suitable for these observations. Spectral lines were found which correspond to a high degree of excitation of atoms possessing double the initial energy. The reactions $Na + HgCl_2$, $Na + Cl_2$, $K + Cl_2$ show a typical variation of energy in the spectrum of mercury, the maximum corresponds to double the energy of the nascent particles. It is shown that in the chemical luminescence, four molecules of NaCl can concentrate their heat of formation through the excitation by one atom of mercury. F. J. B.

1214. Photosensitised Band Fluorescence of OH, HgH, NH, H_2O and NH_3 Molecules. E. Gaviola and R. W. Wood. *Phil. Mag.* 6. *pp.* 1191–1210, *Dec.*, 1928.

Several band spectra had been previously observed as a result of photosensitised fluorescence. The conditions for the appearance of these bands has now been determined and the probable chemical processes suggested. The dissociation energy of water into H and OH is probably about 5·2 volts and not less than 4·9 volts, as assumed by Senftleben and Rehren; while that of the nitrogen molecule is about 9·8 volts and not 11·4, as calculated by Sponer and Birge. The concentration of OH and NH is of the order of concentration of excited mercury atoms (10^{-5} mm. pressure). The results of collisions of excited mercury atoms are discussed. F. S.

1215. Interpretation of the Atmospheric Absorption Bands of Oxygen. R. S. Mulliken. *Phys. Rev.* 32. *pp.* 880–887, *Dec.*, 1928.

It is shown that the atmospheric oxygen absorption bands can be attributed to a $^3S \rightarrow {}^1S$ transition from the normal (^3S) to a metastable ^1S excited state of O_2. This accounts for all the strong lines, and explains missing lines, without conflict with existing theory. Certain very weak series such as the A′ band are, however, not yet explained. Of the three rotational levels for each value of j_k in the ^3S normal state, the two for which $j = j_k \pm 1$ show only a very small separation, which increases slowly with j_k, while the third is separated from the other two by an interval of about two wave-numbers which does not change with j_k. The ^3S and ^1S states involved in the atmospheric bands may perhaps be attributed both to the same electron configuration, in agreement with a suggestion made in a previous paper. If this is the case, it is likely that a metastable ^1D state derived from the same configuration also exists, and that infra-red atmospheric bands corresponding to the transition $^3S \rightarrow {}^1D$ should be found. AUTHOR.

1216. Spectral Excitation by Recombination in the Electric Arc. Jane M. Dewey. *Phys. Rev.* 32. *pp.* 918–921, *Dec.*, 1928.

Recent measurements of electron velocities in arcs have made it probable that most of the light in the negative glow is emitted as a result of recombination of positive ions and electrons. Since the velocities of the positive ions are high, spectral lines emitted in this way should show Doppler broadening. This broadening was measured photometrically for a hot kathode arc in helium in which measurements of electron velocities were also made, and results were obtained which can be explained by assuming all of the light in the negative glow to result from recombination of ions having a temperature about one-tenth that of the electrons. AUTHOR.

1217. Secondary Radiation Observed during the Molecular Scattering of Light (Raman Effect). P. Daure. *Comptes Rendus*, 187. *pp.* 940–941, *Nov.* 19, 1928.

An attempt has been made to study the relation between the atomic weight and the Raman effect in the two series of compounds, the trichlorides of phosphorus, arsenic antimony, and bismuth, and the tetrachlorides of carbon, silicon, titanum and tin. Phosphorus tribromide has also been studied. The Raman lines observed are normally four in number. The frequency of these lines decreases regularly with the atomic weight of the elements. The relationship between the frequency of a given Raman line and the atomic weight cannot be expressed simply. F. J. W.

1218. Raman Lines under High Dispersion. R. W. Wood. *Phil. Mag.* 6. *pp.* 1282–1283, *Dec.*, 1928.

Since the first paper [see Abstract 513 (1929)] on the Raman effect, the author has photographed the spectra scattered by benzol and carbon tetrachloride with a 6-in. plane grating combined with a lens of 3-metre focus; the plates are included together with the wave-lengths of the strongest lines. H. H. Ho.

1219. Total Reflection of X-Rays from Nickel Films of Various Thicknesses. H. W. Edwards. *Phys. Rev.* 32. *pp.* 712–714, *Nov.*, 1928.

The total reflection of X-rays ($\lambda = 0{\cdot}707$ Å) is obtained from mirrors of sputtered nickel films having thicknesses from 0 to $3{\cdot}3 \times 10^{-5}$ cm. The measured critical angles were found to vary from a minimum value of 0·0016 radian, that of blank glass to a maximum value of 0·00339 radian, which was obtained from the thickest nickel film. A satisfactory agreement between the maximum experimental value of the critical angle and that calculated by the Lorentz dispersion formula in which the density of nickel was placed at 8·75 gm./cc., is used as evidence for concluding that the density of the nickel is entirely normal, and also that the thickness of sputtered metal films which are to be used in X-ray reflection phenomena must be sufficiently large or misleading results may be obtained. The critical angle from a thick silver-sputtered mirror was found to be identical with that obtained from a chemically prepared silver mirror, which indicates that the density of silver is independent of the method of deposition. AUTHOR.

1220. Diffused X-Rays. F. Vierheller. *Univ. Nac. La Plata, Estudio Ciencias, No.* 86. *pp.* 315–348, *Nov.*, 1928. *In Spanish.*

Investigation into the quality and quantity of X-rays diffused in water, apart from those of the exciting rays. There is agreement between the observed and the calculated values. An energy maximum occurs at a depth of about 1 cm., this depth increasing with the volume of liquid examined. For the diffused radiation alone this maximum lies at the depth of 3 cm., and appears to approach the surface as the volume not affected by direct radiation increases. The interaction of the primary and the secondary radiations is the cause of the maximum lying in any case 1 cm. below the surface. The logarithms of the ionisation currents produced by the diffused radiations are inversely proportional to those volumes which are not affected by direct radiation, above about ½ litre; the curve between 0 and ½ litre is plotted. Where there is a maximum quantity there is always a minimum quality. The effective wave-length of the secondary radiation is markedly greater than that of the primary. A. D.

1221. X-Ray Diffraction of Crystal Powders and Liquids in Relation to their Constitution. P. Krishnamurti. *Ind. Journ. Phys.* 3. *pp.* 225–240, *Nov.* 30, 1928.

A number of organic liquids have been examined to correlate their constitution with their X-ray diffracted patterns. The ortho di-substituted benzine derivations showed the presence of two rings and para compounds of only one. *n*-Butyl benzoate showed a very faint inner ring in approximately the same position as on the salicylate. Geraniol and terpineol showed some differences, the former giving a broader and more diffuse halo, while the latter gave a clearly defined one. The inner ring due to double molecular spacing was smaller in the case of geraniol than in terpineol, showing that the former consisted of longer molecules. Some benzene derivatives with a long side-chain gave rings of about the same size as in a long-chain aliphatic derivative like oleic acid. Some ortho di-substituted compounds and one meta- and one para-compound were examined, both in the powder and in the liquid states. The two liquid patterns in the ortho- and meta-compounds showed the two rings present in the powder pattern, the outer one having contracted, and the inner one of practically the same size. The rings were broader and more diffuse at the edges in the liquids. The changes in the diffraction patterns when passing from the solid to the liquid state are discussed in the light of the theory of Raman and Ramanathan. A. B. W.

1222. Diffraction of X-Rays by Aqueous Solutions of Cane-Sugar, Levulose and Glucose. P. Krishnamurti. *Indian Journ. Phys.* 3. *pp.* 209–223, *Nov.* 30, 1928.

X-ray diffraction of cane-sugar, levulose and glucose, both in the powder form and in their aqueous solutions, at different concentrations has been studied experimentally, using the Cu Kα radiation. A dilute solution of sugar gives a pattern consisting of the outer ring due to water, and a corona which immediately surrounds the central spot, and is due to a relatively intense scattering at small angles. With increasing concentration of the solution, the corona increases in intensity till a concentration of about one part of sugar to one of water is reached. This corona is attributable to the molecules of the dissolved substance which are distributed at random in the solvent in much the same way as gaseous molecules. These dissolved molecules give rise to a scattering which is large at small angles, and decreases at large angles. Van't Hoff's theory of solution thus finds a direct experimental verification by means of X-ray diffraction. At a concentration higher than 1 : 1, however, the corona is modified and develops into a halo on account of a marked diminution of the intensity of scattering at small angles. This phenomenon may be interpreted as due to the dissolved molecules in a concentrated solution acquiring an approximately uniform spatial arrangement, and in consequence the scattered waves at small angles destroying each other's effects by interference. At still higher concentrations the halo develops into a well-defined ring with a clear space at the centre, the ring increasing in diameter with increasing concentration. The pattern for the most concentrated solution examined is very much like the pattern for the powder. A. B. W.

1223. Dispersion of Röntgen Rays in Mercury Vapour. P. Scherrer and A. Stäger. *Helv. Phys. Acta,* 1. 7–8. *pp.* 518–533, 1928. *In German.*

From the measurements of the dispersion of Röntgen rays in mercury vapour, the author calculates the scattering function of mercury atoms. This scattering function, F curve, is found to be of the same shape as the F curves obtained from crystal interference measurements, and also gives the amplitude of the scattered rays as a function of the scattering angle.

A perfectly smooth F curve is obtained, without even the slightest trace of maxima being shown. R. C. F.

1224. Scattering of Quanta with Diminution of Frequency. K. K. Darrow. *Science*, 68. *pp.* 488–490, *Nov.* 16, 1928.

Mentions at least four, and perhaps five, cases in which quanta appear to surrender part, but not the whole, of their energy in excitation of molecules (Raman), in excitation of vibrations in crystal lattices (Raman, Landsberg and Mandelstam) in collisions with free electrons (Compton), in ionisation of atoms by removal of inner electrons (Duane and Clark). The author considers that in these cases it is not a question of the original quantum disappearing and a new quantum with smaller frequency being produced, but that the original quantum simply loses part of its energy. Electrons also possess the properties of wave motion, the wave-length changing with the velocity. It would not be suggested that when the velocity of an electron changes the original electron is destroyed and a new one formed with a different wave-length. There are other cases where an atom absorbs a quantum of energy, and after an interval gives out another of different frequency, the two quanta are then distinct from one another. H. N. A.

1225. Scattering Coefficient of Hydrogen According to Wave Mechanics. J. A. Stratton. *Helv. Phys. Acta*, 1. 1. *pp.* 47–74, 1928. *In German.*

The investigation is concerned with the scattering of X-rays with unchanged wave-length. The Schrödinger equation for the perturbed system of a hydrogen atom in the field of the primary radiation is written down, and a solution in series obtained which is valid in the region where the wave-length is comparable with the linear dimensions of the scattering atom. It is shown that not only is the intensity of the scattered radiation a decreasing function of the frequency, but also the spatial distribution of the scattered rays is similar to that of the Compton rays. The observed decrease of the unmodified line intensity with increase in primary frequency is not, therefore, to be explained simply as due to the larger number of electrons which are appropriated to Compton scattering. W. S. S.

1226. Nature of the X-Ray Interference Lines from Multi-Crystalline Materials. H. Möller and A. Reis. *Zeits. f. phys. Chem.* 139. *pp.* 425–438, *Dec.*, 1928.

A mathematical paper dealing with the structure of the lines obtained by reflection of X-rays from rods of compressed crystalline particles (Debye-Scherrer arrangement). The effect of crystal grain size is considered in relation to the width of the lines. A. B. W.

1227. Colouration of Kunzite and Hiddenite by X-Rays. P. L. Bayley. *J.O.S.A. and R.S.I.* 17. *pp.* 350–355, *Nov.*, 1928.

The change in colour was investigated spectrophotometrically in the infra-red, the visible spectrum and the ultra-violet. With the crystals employed the curve for the kunzite differs perceptibly from that of the hiddenite. No marked change was observed in the hiddenite after exposure to X-rays, though the absorption in the visible portion of the spectrum was slightly increased. Doelter found that with the specimen he investigated the hue of the radiated hiddenite changed to the more greenish blue of radiated kunzite, but this did not appear with the author's specimen.

The original colour of the kunzite was regained after twelve hours' exposure to the light of a 150-watt Mazda lamp. H. N. A.

1228. Production of Colour in Glass and Gems by X-Rays and Radium-Rays. M. C. Reinhard and B. F. Schreiner. *J. Phys. Chem.* 32. *pp*. 1886–1887, *Dec*., 1928.

Since glass is coloured as a result of radiation and contains silicates, several gems, some containing silicates, were tested similarly. Very intense X-rays and β- and γ-rays from radon had no effect after prolonged exposure on topaz, aquamarine, amethyst, garnet, white diamond, and brown diamond. The white diamond gave blue fluorescence with radon, but none of the other gems fluoresced. Natural quartz crystals were unaffected by intense X-rays, but fused quartz showed an irregular brown colouration. [See Abstract 581 (1925).] R. S. R.

1229. Absolute X-Ray Wave-Length Measurements. A. P. R. Wadlund. *Phys. Rev.* 32. *pp*. 841–849, *Dec*., 1928.

By means of a speculum metal grating, 50 lines to the mm., ruled over a length of 5 mm., the wave-lengths of the Kα_1 line of copper, iron and molybdenum were determined as $1{\cdot}5373 \pm 0{\cdot}0008$, $1{\cdot}937(6) \pm 0{\cdot}002(3)$ and $0{\cdot}708(3) \pm 0{\cdot}001(1)$ Ångströms respectively. Using the Kα_1 line of copper the following constants were calculated: the grating space of calcite $3{\cdot}0290 \pm 0{\cdot}0016$Å, Avogadro's number $(6{\cdot}061 \pm 0{\cdot}009) \times 10^{23}$ molecules per gramme molecule, and the electronic charge $(4{\cdot}774 \pm 0{\cdot}007) \times 10^{-10}$ e.s.u. A discussion is given of the sources of error involved, of which the most important are those due to the settings on the lines of the diffraction pattern and those due to the inexact setting of the grating. [See Abstract 3049 (1928).] AUTHOR.

1230. New High Potential X-Ray Tube. C. C. Lauritsen and R. D. Bennett. *Phys. Rev.* 32. *pp*. 850–857, *Dec*., 1928.

An attempt has been made to develop apparatus and methods of operation for generating and investigating X-rays in the region beyond 300 kV. A tube is described which was designed to operate with 1000 kVA, one million volt transformers available at the California Institute of Technology. The tube is built up of glass cylinders internally shielded against electronic bombardment. The phenomenon of "cold emission" is utilised for obtaining the electrons, the full potential being applied between electrodes of suitable curvature placed close together (1 to 2 cm.). A preliminary report of the results is given. This includes oscillograms showing the peculiarities of the current due to "cold emission" as well as the actual potential across the tube. Absorption measurements of the X-rays have been made with lead up to 2 cm. thick, and it is shown that secondary emission plays an important part in the photochemical action of these rays. Satisfactory operation has been obtained up to 750 kV. AUTHORS.

RADIOACTIVITY.

1231. Quantum Mechanics of the Radioactive Nucleus. G. Gamow and F. G. Houtermans. *Zeits. f. Physik*, 52. 7–8. *pp*. 496–509, 1928.

Further details of Gamow's theory [see Abstract 532 (1929)] are worked out. The following formula is derived for the disintegration constant λ :

$$\log_e \lambda = \log_e \frac{64\pi^2 me^2}{h^2} + \log_e Z^*v + 2\log_e \tan u_0 - \frac{8\pi e^2}{h}\frac{Z^*}{v}(2u_0 - \sin 2u_0),$$

where $Z^* = Z - 2$ is the residual charge on the nucleus after emission of an α-particle, v is the final velocity of the ejected α-particle,

$$\cos u_0 = \frac{v}{\sqrt{Z^*}} \cdot \frac{1}{2e}\sqrt{mr_0},$$

and r_0 is the effective radius of the nucleus (defined in a special way). The values of r_0 deduced from the experimental values of λ and v for the emanations in the three disintegration series are given in the accompanying table:

Element.	$r_0 \times 10^{13}$.	$\Lambda \times 10^{13}$.
Ra Em	7·35	6·15
Th Em	7·25	5·74
Ac Em	6·63	5·50

It is noteworthy that the r_0 values agree approximately with the de Broglie wave-lengths of the expelled α-particles (shown in column 3). Using the above values of r_0, curves relating $\log_e \lambda$ to $\log_e v$ for the three radioactive families are drawn, and the observational points shown to lie close to the theoretical curves. A number of discrepancies occur. In particular, in passing along the series in "historical order," there is a tendency for the ratio $\log_e \lambda$ exp./$\log_e \lambda$ theor. to decrease. In the above theory it is assumed that the Schrödinger waves involved are those corresponding to zero azimuthal quantum number. The occasional emission of extremely high velocity α-particles may, it is suggested, correspond to the occurrence of non-zero azimuthal quantum numbers. W. S. S.

1232. Quantum Theory of Atom Disrupture. G. Gamow.

Zeits. f. Physik, 52. 7–8. *pp.* 510–515, 1928.

An upper limit to the probability of the artificial disintegration of an atom by α-particle bombardment is provided by the probability that the α-particle penetrates the nucleus. According to wave mechanics the latter probability is finite even when the α-particle has to pass through a region of "negative kinetic energy" before reaching the domain of the attractive forces. The theory developed is similar to that for radioactive disintegration [see Abstract 532 (1929) and preceding Abstract], except that here the *converging* Schrödinger waves are involved. The computed relative probabilities for the penetration of aluminium atoms by α-particles of different velocities are shown to be in agreement with the observed disintegration yields. In addition, the absolute probabilities are estimated for the penetration of different atoms by α-particles of a given velocity. The disintegration-yield results of Rutherford, and of Bothe and Fränz, agree tolerably well with the theoretical estimates, and it is concluded that for disintegrable elements a proton is almost always split off when an α-particle penetrates the nucleus. The probabilities of penetration for heavier atoms, such as iron, are found to be infinitesimal (using RaC′ α-particles), a result in complete disagreement with the observations of the Viennese workers. W. S. S.

1233. Quantum Theory of Nuclear Disintegration. G. Gamow. *Nature*, 122. *pp.* 805–806, *Nov.* 24, 1928.

An outline is given of investigations by Gamow and Houtermans and Gamow [see the two preceding Abstracts], applying wave mechanics to radioactive and artificial disintegration of atoms. Several further points are emphasised. In particular, if the critical radius r_0 for the different elements in a radioactive family be assumed not a constant but proportional to the cube root of Z, an almost perfect fit between theory and experiment is obtained for the relation between disintegration constant and ejected α-particle velocity. Such values of r_0 make the nuclear volume nearly proportional to the number of constituent α-particles, and an extrapolation to light elements gives a critical radius for aluminium in good agreement with Bieler's value deduced from deviations in inverse square law scattering. W. S. S.

1234. Scattering Power of a Bare Nucleus According to Wave Mechanics. G. Temple. *Roy. Soc., Proc.* 121. *pp.* 673–675, *Dec.* 3, 1928.

Gives a simple and direct method for deriving the results obtained by Mott for the scattering of an infinite plane wave by a bare nucleus [see Abstract 1938 (1928)]. Defines the scattering power of a nucleus as the volume density of electricity in the scattered wave, when the volume density of the incident wave is unity around the nucleus. Elementary solutions of the wave equation are obtained, the analysis being made simpler by using paraboloidal coordinates instead of spherical polar coordinates; it is shown that only one of these solutions is physically admissible. This gives a value for the scattering power of the bare nucleus which is identical with the classical value obtained by Rutherford. H. N. A.

1235. Production and Properties of High-Frequency Radiation. E. Rutherford. *Nature*, 122. *pp.* 883–886, *Dec.* 8, 1928.

Deals essentially with possible sources of the high-frequency radiation of supposed cosmic origin studied by Millikan and Cameron. It is suggested that these may be the result of the release of intrinsic energy from electrons and protons. If a single electron and proton disappear together and their intrinsic energy (related to their mass by the Einstein relation, $E = mc^2$) is emitted as a single quantum, we have a γ-radiation of frequency corresponding to about 940 million volts. The interesting point is that the absorption coefficients of the most penetrating cosmic radiation measured by Millikan and Cameron is in good agreement with that to be expected on the Klein and Nishina theory of scattering for a quantum energy of 940 million volts. G. E. B.

1236. Action of Light on Potassium Chloride. J. Risler and F. de Courmelles. *Comptes Rendus*, 187. *pp.* 944–945, *Nov.* 19, 1928.

It is found that exposure of potassium chloride to light increases its radioactive properties. Ultra-violet light is the most effective. F. J. W.

1237. Mode of Action and Construction of a Counter Tube. H. Geiger and W. Müller. *Phys. Zeits.* 29. *pp.* 839–841, *Nov.* 15, 1928. *Paper read before the Deut. Naturforscher u Ärzte, Hamburg, Sept.*, 1928.

A thin wire covered with a badly conducting layer of uniform thickness is stretched along the axis of a metal tube; the tension between the tube and the wire can be raised above the ordinary sparking potential owing to the insulating action of this layer. If a small number of ions is produced at a point in the tube there is a strong multiplication of the rush of current, and for a moment a considerable quantity of electricity flows along the wire. With a bare wire a continuous discharge would take place, but with the insulated wire the current stops very quickly. The arrangement can be used to show the passage of single corpuscles, α- and β-rays, and so on, and is superior to the point counter as the opening to the latter measures only a few millimetres, while with the counter tube surfaces of 100 cm.^{2} and over can be made use of. The sensitiveness is greater than in any other method. Examples are given of the use of the instrument to measure the β-radiation of potassium, Hess high-altitude radiation and X-radiation. It can also be used for γ-radiation. It should be noted that the radiation investigated is admitted through the sides of the metal tube, which is closed at the ends and evacuated. In the experiments on potassium β-radiation the whole tube was surrounded with potassium chloride.

H. N. A.

1238. Scattering of α-Rays by Helium. W. Hardmeier. *Helv. Phys. Acta,* 1. 3. *pp.* 193–207, 1928. *In German.*

The object was to determine whether with both the α-particles and the He nucleus a polarisibility and, thus, a displacement of its charges exist. The anomalous scattering of Al and Mg helps because there the polarisibility of both nuclei encountered act additively. The scattering of an α-ray bundle is calculated for the case where both it and the nucleus are polarisable. The results were compared with those of Rutherford and Chadwick [see Abstract 3148 (1927)]. In contrast with the heavier bodies the complicated scattering cannot be explained completely by the charge and polarisability of the nucleus. For the He nucleus a very small polarisability results, which indicates a strong force of attraction between the components of the nucleus. The polarisability found is $1 \cdot 6 \times 10^{-39}$ cm.^{3}, a value very small compared with the volume and $\frac{1}{300}$ that of the Al nucleus. On classical mechanics the author supposes that the He nucleus acts as a hard but completely elastic rotating ellipsoid moving in the direction of its minor axis.

R. S. R.

1239. Fluctuations of the Ionisation of Individual α-Particles. H. Greinacher. *Helv. Phys. Acta,* 1. 7–8. *pp.* 534–536, 1928. *In German.*

Discusses the methods used by various authors who have measured the ionisation of α-particles, in an endeavour to find the cause of the fluctuations which occur. The results considered are those obtained by Ramelet [see Abstract 204 (1929)], who used the present author's method [see Abstract 3145 (1927)], and those obtained by Ziegert [see Abstract 1314 (1928)], using Hoffmann's method [see Abstracts 2318 and 2319 (1927)]. It is concluded from a consideration of the methods that it is not possible to give reasons for the different results obtained in each case.

R. C. F.

HEAT.

1240. Thermal and Electrical Conductivities of a Copper Crystal at Various Temperatures. W. G. Kannuluik and T. H. Laby. *Roy. Soc., Proc.* 121. *pp.* 640–653, *Dec.* 3, 1928.

The thermal conductivity of a copper crystal at various temperatures was determined by the thermal method. The heat losses were made small by using a high vacuum, and at room-temperature were eliminated. The thermal conductivity λ was found to be 0·989 cal. cm. sec. deg. at 19·4° C., 1·054 at − 73·7° C., and 1·131 at − 174·8° C. The value of λ at 19·4°C. is about 4 % greater than that of polycrystal copper—agreeing with Schott's work—but the values found for λ at the lower temperatures are considerably less than Schott's values. Thus, Schott's number for λ at − 174·8° is 1·25. The electrical conductivity k of the single crystal was found to be the same as that of ordinary copper. At 90·1° K. the value of k was $311 \cdot 6 \times 10^4$ ohm^{-1} cm.$^{-1}$. The values of the Wiedemann-Franz constant λ/kT^2 obtained are $1 \cdot 69 \times 10^{-8}$ watt-ohm deg.$^{-2}$ at 90·2° K., and $2 \cdot 42 \times 10^{-8}$ at 273·2° K. J. J. S.

1241. Buckling of a Thin Circular Plate by Heat. F. E. Relton. *Phil. Mag.* 6. *pp.* 1217–1231, *Dec.*, 1928.

A thin, plane, circular disc is considered, of uniform temperature and thickness, whose periphery is prohibited from radial movement. The paper gives a calculation of the deflections and stresses engendered when buckling occurs, the elastic limit being supposed not to be reached. Three equations are deduced from first principles, of which two, however, are sufficient. The discussion includes both the clamped and the unclamped plate, the method used being more efficacious in the latter case. The paper is entirely mathematical. T. B.

1242. Sensitive Thermo-Regulator. D. H. Black. *Journ. Sci. Instruments*, 5. *pp.* 376–377, *Dec.*, 1928.

The paper gives a brief description of a simple thermo-regulator for the control of electrically heated air ovens. AUTHOR.

1243. Device for Accurate Timing. H. L. Johnston. *J.O.S.A. and R.S.I.* 77. *pp.* 381–385, *Nov.*, 1928.

Time signals, received every second, work through a relay a special electromagnet which turns a wheel with fifty-nine teeth. At the end of a complete revolution a latch is raised, and a reversal switch of the Dorsey-White type [see Abstract 367 (1911)] is thrown in, the electric circuits of which are opened and closed by almost identical mechanisms so that the time error of mechanical lag is cancelled out. In the time signals a pause of 2 seconds follows the 59th second; the phase of the sprocket wheel is so adjusted that the latch trips on the signal following the pause. Any loss of a second by a sticking contact is thus detected. An accuracy of 3×10^{-3} sec. is obtained. The device is used for calorimetric work. H. B.

1244. Spark Ignition. E. T. Jones. *Phil. Mag.* 6. *pp.* 1090–1103, *Dec.*, 1928.

An early observation by Thornton [see Abstract 83 (1915)] is referred to as well as an explanation by Jones, Morgan and Wheeler. The observation that the heat dissipated in a spark just sufficient to cause ignition is less if the spark is produced by a condenser discharge than if it is produced by separating the electrodes from contact so as to interrupt a current in an inductive circuit is explained by the view that spark ignition depends upon the volume of the gas which the spark can by its own heat raise to the ignition temperature. From the experimental and deductive evidence in the present paper the writer is of the opinion that the thermal theory is the only theory capable of accounting for the known facts of spark ignition. J. K.

1245. Characteristic Equation of Ideal Monatomic Gas. G. Polvani. *N. Cimento*, 5. *pp.* 331–340, *Nov.*, 1928.

Applying the virial and the principles of thermodynamics to adiabatic transformations, the general form of the equation is found to be $pV = NkT\phi(A)$, where p, V, N, k, T have their usual meanings, A is the "total action" possessed by the gas (*i.e.*, the product of the sum of the quantities of the motion of the molecules into the cube root of the volume V), and ϕ is a function depending on the manner in which the statistics of the gas are worked out. Two different ideal monatomic gases containing the same number of molecules, and always at the same temperature, tend to acquire the same internal energy when the temperature and volume approach infinity, and to acquire the same "total action" when these approach zero. A. D.

1246. States of Aggregation of Helium. W. H. Keesom. *Nature*, 122. *pp.* 847–849, *Dec.* 1, 1928.

The low value of its interatomic forces renders helium the ideal thermometric gas, being nearer to the ideal gas than any other. Its low critical temperature and boiling point allow the temperature scale to be descended to the immediate neighbourhood of the absolute zero. The apparatus by K. Omnes for the liquefaction of helium is described and illustrated diagrammatically, the results showing that by the use of helium a temperature of 0·8° approx. is brought within reach with a boiling point of 4·2° absolute. The author's experiments on the solidification of helium are described, and it is shown that in order to accomplish this the solidification requires not only a temperature at which the interatomic forces overcome the thermal motion so that the atoms may be fixed in the crystalline lattice, but also the application of an external pressure sufficiently great to permit of free play for these interatomic forces. The co-existence of gas and solid, and hence sublimation below the critical temperature of helium appear to be impossible. At the pressure of 90 atmospheres used the densities and refractive indices of the three states are nearly identical. The dielectric constant of liquid helium undergoes a sudden or very rapid change at about 2·3° absolute, coinciding with the value of Omnes and Boks for the temperature of maximum density. Two liquid modifications of helium apparently exist, helium I being stable above 2·3° and helium II at lower temperatures. The density of helium I is 0·1 % higher than that of helium II. The apparent discrepancy in the results of Dana and Omnes for the specific heat of helium at temperatures near 2·3° is explained by the heat of transformation of helium I into Helium II, this being calculated to be about − 0·13 cal. per gm. Helium has a triple point, *viz.*, Helium I–Helium II–Vapour. This is the subject of further investigation. S. G. B.

1247. New Equation of State for Fluids. Parts II and III. J. A. Beattie and O. C. Bridgeman. *Am. Chem. Soc., J.* 50. *pp.* 3133–3138 *and* 3151–3157, *Dec.*, 1928.

Part II deals with the application of a new equation of state [see Abstract 2953 (1927)] to helium, neon, argon, hydrogen, nitrogen, oxygen, air and methane, with respect to the compressibility measurements, the values of the constants being given for these gases and for carbon dioxide and ethyl ether. A method is outlined for transforming the experimental pressure-volume-temperature data into isometric form, and a brief description of the procedure for evaluating the constants of the equation of state is given. Comparison of the observed pressures and those calculated from the equation have been made at 1777 points for these ten gases, the average deviation being 0·08 atmos., or 0·18 % over the entire temperature and density range considered.

Part III employs the equation of state (*loc. cit.*) to calculate values of the ratio at 0° of the pV products at one atmosphere and at zero pressure for several gases, and a brief discussion is given concerning the merits of this particular method and its accuracy. The ratios are then employed to compute the weights of a normal litre of hydrogen, oxygen, nitrogen, carbon dioxide and methane, good agreement being obtained with accepted values. It is claimed that the equation of state extrapolates to low pressures with a high degree of accuracy. H. H. Ho.

1248. Molecular Association. Part I. Relations between Vapour Pressure of Binary Liquid Mixtures and the Polarity of the Molecules Formed. J. Errera. *Zeits. f. phys. Chem.* 138. *Abt. A.* 5. *pp.* 332–344, *Dec.*, 1928.

In this investigation the connection is sought between the results of vapour pressure and polarity measurements in binary liquid mixture whose components do not chemically react. Two kinds of association have to be distingusihed, *viz.*, dipole-association and that due to the van der Waals forces. The experimental data indicate two rules: (1) In the case of negative azeotropy or concave vapour pressure curves, both components are polar or partly ionised. (2) In binary mixtures, where both components are not polar, or only one is polar, the vapour pressure curve is either a straight line or convex, and azeotropy, when present, is positive. The investigation of temperature influence has confirmed the given interpretation of the results. H. H. Ho.

1249. Suitable Gas Mixtures for Different Investigations According to the Wilson Cloud Condensation Methods. Lise Meitner. *Zeits. f. phys. Chem.* 139. *pp.* 717–721, Dec., 1928.

A review of the theory and a note on the most suitable mixture for the investigation of specific problems where cloud condensations are required. The paper is brief, and contains a review of mixtures used by other workers, together with suggestions for suitable mixtures for other experimental purposes. S. G. B.

1250. Constitution and Thermochemistry. A. Gosselin and M. Gosselin. *Comptes Rendus*, 187. *pp.* 1050–1052, *Dec.* 3, 1928.

Based upon the valency theory of Werner, a method of calculating the heats of formation of inorganic and organic compounds was developed. The method required a knowledge of the heats of formation of the different groups and radicals entering into the compound, and the atomic heats of dissociation. The method was applied to the calculation of the heat of formation of urea in the gaseous state. The value obtained was 72·3 calories, and a heat of vaporisation of 8·5 calories. F. J. B.

1251. Symmetrical and Antisymmetrical Hydrogen and Third Law of Thermodynamics. Thermal Equilibrium and Triple Point Pressure. W. F. Giauque and H. L. Johnston. *Am. Chem. Soc., J.* 50. *pp.* 3221–3228, *Dec.*, 1928.

Reference is made to the suggestion of Heisenberg that hydrogen and other homopolar molecules exist in two forms, and to the application of this suggestion by Dennison to explain the heat capacity of hydrogen gas over the low-temperature range in which it is taking up its rotational degrees of freedom. Vapour-pressure values are compared for ordinary hydrogen and for hydrogen kept at the temperature of liquid air for 197 days. The triple point pressure of ordinary hydrogen is found to be 5·38 ± 0·01 cm. The value for the special hydrogen is 5·34 cm. This difference cannot be accounted for from any source of experimental error. J. K.

1252. Thermodynamical System of Rochefort. J. Auclair and J. Villey. *Comptes Rendus*, 187. *pp.* 699–701, *Oct.* 22, 1928.

The characteristic of the Rochefort system is to combine, for the formation of the combustible mixture, the techniques of thermal pulverisation and mechanical pulverisation. This association gives, at a lower cost, a more perfect result, and avoids the high pressures associated with simple mechanical pulverisation. A short study of the cycle and theoretical diagrams of a motor functioning according to the Rochefort system is given. In this system the mechanical diagram is deformed by the injection of the emulsion, which raises temporarily the pressure in the cylinder, and the diagram is no longer a true thermodynamical one, since the gaseous mass varies in the cylinder. The effect is illustrated and explained. T. B.

1253. Heat Capacity and Entropy of Barium Bromate. Entropy of Bromate Ion. B. S. Greensfelder and W. M. Latimer. *Am. Chem. Soc., J.* 50. *pp.* 3286–3290, *Dec.*, 1928.

The heat capacity of crystallised barium bromate, $Ba(BeO_3)_2 . H_2O$, was determined between 16·36° and 295·88° K. From this the entropy at 298·1° K. was calculated as 80·72 E.U. The heat and free energy of solution at this temperature were then determined (15,064 and 7171 cal. respectively), and from these the value of ΔS_{sol} deduced as 26·48 E.U., whence, with the aid of previously determined data, the entropy of the bromate ion at 298·1° K. is found to be 43·6 E.U. ($S^0_H = 0$). C. A. S.

SOUND.

1254. Sonic Interferometer for Velocities of Sound in Liquids. A. L. Loomis and J. C. Hubbard. *J.O.S.A. and R.S.I.* 17. *pp.* 295–307, *Oct.*, 1928.

Using a quartz piezoelectric oscillator (5 cm. diameter, 6 mm. thick) as a source of high-frequency sound waves (500,000 p.p.s.), precision measurements of wave-lengths have been made at various temperatures in several liquids: water, mercury, salt solutions and organic liquids. The method of measuring the velocity by resonance—the production of stationary waves of known frequency and the measurement of wave-lengths—is similar to that developed by Pierce for gases [see Abstract 341 (1926)]. The method is also being employed to study the thermodynamic properties of liquids. A. B. W.

1255. New Recording Phonograph. L. Hajek. *Akad. Wiss. Wien, Ber.* 137. 2*a*. *No.* 8. *pp.* 529–538, 1928.

A full description, with numerous photographs, is given of the recording apparatus hitherto employed by the Phonogrammarchiv, Wien, known as Archivphonograph Type IV, and of a new model, known as Type 1927. The new model is considerably lighter than the earlier one. For constructional details the original paper should be consulted. A. W.

1256. New Acoustic and Particularly Electric-Acoustic Work. F. Trendelenburg. *Zeits. f. Hochfrequenztechn.* 32. *pp.* 27–34, *July ;* 94–99, *Sept. ;* 131–135, *Oct. ;* 173–179, *Nov.*, and *pp.* 202–206, *Dec.*, 1928.

The author provides a general review on a large scale of recent work in acoustics and electro-acoustics. From theoretical considerations, developed earlier [see Abstract 744 (1927)], the author considers the improvement and development of methods of measurements in acoustics. A review is given of work in other branches in acoustics and sound processes in the surrounding air. The general features of various sources of sound, such as electromagnetic and electrostatic loud speakers and gramophone recorders are considered and types of sound receivers. The limiting regions of sound and physiology, and of speech and hearing, are also dealt with. R. S. R.

1257. Coefficients of Transmission, Reflection and Absorption of Sound. K. Satô. *Imp. Acad. Tokyo, Proc.* 4. *pp.* 521–524, *Nov.*, 1928. *In English.*

A brief description is given of a simple experimental method of measuring the coefficients of absorption, etc., of sound in fabric-like materials. The material covers the mouth of a conical horn which connects at its apex with a small resonator tuned to a steady source of continuous sound. At the junction of the horn and the mouth of the resonator is mounted a Rayleigh disc, which serves to measure the sound intensity. The theory of the method is outlined, with particular reference to the transmission of sound through a number of equally spaced parallel layers of material—

allowance being made for the multiple reflections between the various layers. It is found, as theory predicts, that the coefficients of absorption, transmission and reflection are functions of the frequency of the sound. Certain peculiarities are noted. In the case of fabrics the transmission and absorption coefficients *decrease* with increase of frequency, whereas in thick and dense felt or carpet the coefficient increases with increase of frequency. A. B. W.

1258. Spreading of Sound in Air after an Experimental Explosion. O. Meisser. *Phys. Zeits.*, 30. pp. 170–175, *March* 15, 1929.

The paper gives an account of experiments undertaken with the object of trying to explain the well-known phenomena of sound propagation over large areas in which are found zones or areas of silence and well-marked audibility. The area in which the sound is not heard generally begins at about 50 kilometres from the source. At distances between 120 and 170 kilometres the sound is again generally well heard. An elementary account of the propagation of sound waves is given assuming that the velocity is only a function of the height above the earth's surface. In order that the sound may return to the earth's surface at a distance from the source, its velocity at the highest point of its path must be greater than at the earth's surface. The author shows how the velocity at the highest point of the path can be calculated from observations made at the earth's surface. In order to completely determine the path of a ray, we require the height of the apex of the path. An equation is given by which this can be calculated. The method of registering the sound waves at the observation stations and of marking the time intervals is briefly described. The most interesting and important phenomena are the sound reinforcements which arrive later than the normal sound waves and have a correspondingly smaller velocity, which varies between 240 and 305 metres per second, according to the distance from the source and the state of the atmosphere. The velocity at the apex of the path is calculated to be 350–360 kilometres per second and the height of the apex to be between 39–40 kilometres. An explanation of the large velocity at the apex of the path is discussed, and it is concluded that it is probably due to wind effect. Diagrams are given in the paper, together with copies of the received waves and the time signals. T. B.

ELECTRICITY AND MAGNETISM.

THEORY, ELECTROSTATICS AND ATMOSPHERIC ELECTRICITY.

1259. Heating of Mercury in Triboelectricity with Glass. V. Polara. *N. Cimento*, 5. *pp.* 352–360, *Nov.*, 1928.

Mercury 8–24 hours old becomes positive if heated to 40–50° C., and retains this for some 15–50 minutes if slowly cooled in air; but if suddenly chilled it suddenly becomes negative. The phenomenon is reversible; this connects it with the diminution of the superficial tension of the liquid on heating. [See also Abstracts 1951 and 3070 (1928).] A. D.

1260. Electrification of Air by Friction. Agnes W. McDiarmid. *Phil. Mag.* 6. *pp.* 1132–1140, *Dec.*, 1928.

Describes the results of experiments undertaken with the object of discovering whether or not electrification can result from the friction of dry, dust-free air with solid surfaces. A current of air was passed quickly through tubes of various solids into a carefully screened copper vessel, arrangements being made to obtain indications of the charge received by the copper vessel, and also by the tubes. Various metals and insulators were used for the tubes, and in every case it was found that the passage of air through the tubes changed the potential of the vessel. Further, the charge on the tube was always opposite in sign to that of the receiving vessel, although no definite statement could be made regarding its sign; for two insulating and two metal tubes it was positive, and for the others it was negative. An increase in velocity of the air through the tubes increased the charge given to the copper vessel. A discussion of the results obtained is given, in which three possible explanations of the increase in velocity producing an increased charge are suggested. R. C. F.

1261. Wireless Methods of Investigating the Electrical Structure of the Upper Atmosphere. E. V. Appleton. *Phys. Soc., Proc.* 41. *pp.* 43–56; *Disc.*, 56–59, *Dec.*, 1928.

Various direct wireless methods of measuring the "effective" height of the atmospheric ionised layer are discussed and compared. For a layer of horizontal stratification, and under conditions for which the influence of the earth's magnetic field may be neglected, the general equivalence of the quantities measured by the various methods is demonstrated. The effective height in such cases is shown to be greater than the maximum height reached by the atmospheric ray. Proposals for using these methods to obtain information concerning the gradient of ionisation in the layer are put forward. AUTHOR.

DISCHARGE AND OSCILLATIONS.

1262. Spectrographic Investigation of Spark Discharge. U. Nakaya and Y. Fujioka. *Imp. Acad. Tokyo, Proc.* 4. *pp.* 464–466, *Oct.*, 1928.

From a spectographic investigation of various types of spark discharge, as described by Terada and Nakaya [see Abstracts 2459 and 3075 (1928)], a discussion of the energy distribution along the spark is made possible.

In the "three-part" spark there are three district zones in the spectrum. In the positive part the air lines are very noticeable, whilst in the middle part, besides the air lines, the heads of the second positive band of nitrogen and the continuous spectrum appear. The negative part resembles the positive part; the air lines, however, being much weaker. The strongest electric field exists in the positive part, and the negative part is next in strength. The positive band in the middle part only appears when the electric field is rather weak, and thus this part must come last. The "short" spark with "splitted" structure gives a spectrum resembling the middle part of the previous type of spark, and the field is even weaker because the nitrogen bands are more pronounced. The positive part of a "broken line" spark has a much stronger electric field than the negative part, as the types of spectrograms obtained are similar to those for the corresponding parts of the "three part" spark. In the violet flame-like spark, the electric field is the lowest of all the types. This is indicated by the well-developed positive band systems of nitrogen shown by the spectrograms. R. C. F.

1263. Ignition of Gas by a Spark, and its Dependence on the Nature of the Spark. T. Terada and K. Yumoto. *Imp. Acad. Tokyo, Proc.* 4. *pp.* 467–470, *Oct.*, 1928.

Morgan inferred from the results of his investigations regarding the spark ignition of some combustible gas mixtures [see Abstract 1468 (1925)] that the "capacity spark" is in general more effective in igniting the gas than the "inductance spark," the total energy of the spark being the same. According to his thermal theory a heat source of short duration is more effective than one in which the heat is supplied over a large interval. The results here described show that the above general statement may not apply in the case of gases of low inflammability, such as mixtures of CO and air with small percentages of CO. In such cases the propagation of flame in the mixture is of great importance. The question as to whether the flame will be extinguished or propagated will depend on the balance between the heat evolved and that lost by radiation in the period in question; thus, a prolonged supply of energy in the form of a train of sparks, or a continuous glow following the first spark, may be more effective than a single spark of equal energy. A. W.

1264. Alternating-Current Arc in Fluids. A. v. Engel. *Zeits. f. Physik*, 52. 1–2. *pp.* 145–149, 1928.

The effects observed by Bodforss and Frölich [see Abstract 2011 (1922)] are shown to be due to periodic discontinuities of the arc current. Such effects cannot be ascribed to the normal alternating-current arc in liquids. Experiments are described showing perfectly normal effects obtained with an alternating-current arc between copper electrodes in ethyl ether. A. W.

1265. Ionic Oscillations in the Glow Discharge. L. A. Pardue and J. S. Webb. *Phys. Rev.* 32. *pp.* 946–949, *Dec.*, 1928.

In an effort to correlate Whiddington's work on moving striæ and Appleton's work on ionic oscillations from a striated discharge, it was found that the ionic oscillation phenomenon was sufficiently involved to warrant a detailed study. The discharge tube was of the hot kathode type, 3 cm. in diameter and 26 cm. long. The oscillations were detected in three ways:

first, by means of curved plates on the tube which were connected in parallel with the tuning condenser of the receiver; second, by direct inductive "pick-up" from the tube itself; third, by inductive "pick-up" from a coil in series with the tube. By these methods frequencies from 15×10^4 to a few hundred cycles were obtained, the higher frequencies being detected on an autodyne receiver, the lower frequencies on a straight low-frequency amplifier. Characteristic curves obtained show an increase of frequency with filament current, an increase of frequency with anode potential and a decrease with pressure except at the lower pressures where the frequency increases, passing through a maximum. With a varying pressure and without plates on the tube, oscillations do not occur when there are sharply defined striæ, but begin just as striæ begin to diffuse, decreasing in frequency and becoming audible when a uniform glow fills the tube. AUTHORS.

1266. Time Lag of the Spark Gap. J. W. Beams. *Frank. Inst., J.* 206. *pp.* 809–815, *Dec.*, 1928.

A new method of measuring the time lag is described, and results are given for sparks in air at atmospheric pressure. The field strengths used ranged from approximately 60,000 volts per cm. to 400,000 volts per cm., with as steep wave-fronts as could be obtained. The method of measurement is a modification of that previously used to measure the order of appearance of spectrum lines in sparks and condensed discharges [see Abstract 369 (1927)]. A typical set of observations is given for 2 c.m. brass spheres used in both spark gaps, and when points were substituted for the spheres in one gap. As the voltage gradient is raised the time lag is decreased. It is also found that the time lag, especially at the lower field strengths, has not a definite magnitude, but varies over a considerable range of values. In the needle gap the variation is greater than in the sphere gap. When the field strength is increased the value of the time lag becomes more definite, and for the highest field strength used it becomes practically constant. The results are discussed. A. W.

1267. Spark Potentials at Pressures below Atmospheric Pressure, and the Minimum Potential with Respect to the Electrode Function. F. Klingelfuss. *Zeits. f. Physik*, 52. 1–2. *pp.* 126–140, 1928.

Shows that under definite conditions resulting from the electrode function for gas discharges [see Abstract 2744 (1927)] the spark potentials, as theoretically obtained from Einstein's energy equation, are in agreement with experimental results for constant spark length and varying pressures below atmospheric pressure. The minimum potential for air is then found to be unconnected with the electrode separation over a definite wave-length range. The value of this minimum potential is equal to that of the electrostatic c.g.s. unit of potential. R. C. F.

1268. Sparking Potential in Hydrogen. E. Meyer. *Helv. Phys. Acta*, 1. 1. *pp.* 14–17, 1928. *In German.*

Experimental investigation of the effect of traces of moisture on the sparking potential between parallel plates in hydrogen (magnesium electrodes 4·96 mm. apart, with an ebonite spacing ring which shields the region of non-uniform field). The result of moisture is to increase the sparking potential—the increment increasing steadily with increasing partial pressure of water-vapour over the whole range investigated. There is no evidence of the more complicated behaviour observed in similar investigations on sparking potentials in moist air and nitrogen. As a result of the measurements in dry hydrogen, a revision of Carr's data is being undertaken. H. R. R.

1269. Connection between Spark Potential and Volta Effect. R. Bär. *Helv. Phys. Acta,* 1. 3. *pp.* 186–192, 1928. *In German.*

The influence of kathode materials on the spark potential for neon has been definitely shown by Holst and Oosterhuis [see Abstract 952 (1924)]. The present author experimentally determines the connection between spark potential and volta effect for magnesium and silver electrodes in neon. Normally, the volta effect was as usually obtained, but after a few minutes' cleaning action of an alternating glow discharge, the magnesium became negatively charged. This negative charge produced a polarisation of the spark gap of several volts. Considering Millikan's generalised Einstein's connection between the long wave-length boundary of photoelectric effects and the volta effect, it is shown that the relation connecting spark and volta potentials is correct. With regard to the negative charge produced, it is shown that this cannot remain on the metal surface, but must penetrate the inside of the metal, so that the region of origin of the photoelectrons and of the primary electrons of the spark discharge, which are produced by ionic collision, is outside the charged layer. If this were not so, then the action of the polarising layer on the long wave-length boundary spark, and volta potentials could not be explained. R. C. F.

1270. Kathodic Phenomena in a Discharge through Gases. M. Wehrli. *Helv. Phys. Acta,* 1. 4. *pp.* 247–262, 1928.

A set of ten independent equations has been developed which is valid over the region of the continuous discharge. One of the equations has been applied to the case of the tungsten arc in nitrogen and the carbon arc in air with the following results: (*a*) the kathode drop increases for large values of the current to a constant value which corresponds generally with the work function of the material of the kathode; (*b*) the kathode drop increases with the heat loss from the kathode, the rate of increase decreasing with increase in the current; (*c*) the kathode drop is greater, the greater the work function of the material of the kathode and the smaller the ionising potential of the gas. F. J. W.

1271. Kathodic Phenomena during the Transition from the Glow to the Arc Discharge. M. Wehrli. *Helv. Phys. Acta,* 1. 5. *pp.* 323–354, 1928.

Discharges in nitrogen have been studied, using tungsten electrodes. The influence of current strength and length of arc on the kathode drop have been investigated for both glow and arc discharges. For the former, the kathode drop has a minimum value which is independent of the length of the arc over a range of 0·002 to 5 amperes, but which corresponds to a minimum in the current density. For the latter, the kathode drop is influenced greatly by the shape of the electrodes for small values of the current. The striking temperature of the arc has been determined by measuring the temperature of the kathode. Further, from these measurements it is shown that the thermionic current from the kathode is greater than the total current when the latter is greater than 0·2 ampere. The conditions which are favourable to the transition from the glow to the arc discharge are discussed. F. J. W.

1272. Davisson-Germer Effect. K. Schaposchnikow. *Zeits. f. Physik*, 52. 5–6. *pp.* 451–452, 1928.

Davisson and Germer have shown that de Broglie's equation $\lambda = h/mv$ does not strictly hold good. Rupp and others [see Abstract 264 (1929)] have shown that the true relation is $\lambda = h/mv(\mathrm{V}/\mathrm{V} + \mathrm{E})^{\frac{1}{2}}$, where V is an accelerating potential, and E the grid potential. The author derives this relation direct from the mechanical theory of light quanta.

E. E. F. d'A.

1273. Diffraction of Kathode Rays by Mica. S. Kikuchi. *Imp. Acad. Tokyo, Proc.* 4. *pp.* 471–474, *Oct.*, 1928.

In previous work [see Abstract 260 (1929)] the kathode rays used were somewhat heterogeneous. The experiments have now been repeated, using monochromatic rays. For mica sheet so thin that it produces no interference colour at all it was confirmed that the diffraction pattern in this case is due to a two-dimensional lattice in which the scattering centres are arranged in an equilateral triangular network. As the thickness of the sheet increases the mutual influence of the rays scattered by the successive planes becomes effective, and some of the spots are intensified, while the others gradually fade until at last the net-like pattern completely disappears, and only spots similar to Laue's remain visible. At the same time sets of concentric rings and pairs of black and white lines appear. The views previously given of the origin of these patterns were definitely confirmed. From the radii of the rings the distance between the neighbouring molecules along this axis was calculated to be 38 Å.U., which is in agreement with the value 39·6 Å.U. determined by X-ray analysis of the mica used.

A. W.

1274. Diffraction of Kathode Rays by Calcite. S. Nishikawa and S. Kikuchi. *Imp. Acad. Tokyo, Proc.* 4. *pp.* 475–477, *Oct.*, 1928.

Diffraction patterns were obtained for a crystal of calcite. A figure shows the interpretation of this pattern in terms of the intersection of the reflecting net planes of the crystal with the photographic plate. A parallelism with Bragg's results for X-rays also exists, and the structure factor of the net planes has thus great influence on kathode-ray reflection. Similar patterns were obtained with cleavage faces of mica, topaz, zinc blende and natural quartz. In some cases Laue spots were also found, while under certain conditions there were lines due to electrons reflected more than 90°. [See also Abstract 260 (1929).] R. S. R.

1275. Hysteretic Effects in the Positive Emission from Hot Bodies. H. P. Walmsley. *Manchester Phil. Soc., Mem.* 72. *pp.* 139–156, 1927–1928.

Some of the work is reviewed on the properties of the positive ions emitted from hot platinum, in which anomalies have been attributed to the presence of particles. The explanations have been extended by taking account of the properties of the particles when charged. They are then found to give a fairly consistent qualitative account of the time-lag effects when the pressure of the medium is altered, when the temperature is suddenly changed, and when changes are made in the electric fields employed to measure the currents. The effect of particles on the measurements of ϵ/m is discussed. E. E. F. d'A.

1276. Thermionic Current in Dense Gases with Cylindrical Electrodes. H. König. *Helv. Phys. Acta*, 1. 4. *pp.* 277–286, 1928. *In German.*

Confirms the current-voltage characteristic for surface ionisation, which shows a close correspondence with theory. Confirms Greinacher's formula for the region of space charge for pressures between 2 and 720 mm. of mercury. Determines the lowest limit of validity of the formula: $u_p \cdot p =$ const. E. E. F. d'A.

1277. Emission and Reflection of Electrons by Metals. L. W. Nordheim. *Roy. Soc., Proc.* 121. *pp.* 626–639, *Dec.* 3, 1928.

In a recent paper [see Abstract 2172 (1928)] the author showed that the phenomena concerning the emission or reflection of electrons by metals can be treated by calculating the emission or reflection coefficient for the electrons at the surface of the metal and integrating over all incident electrons according to the electron theory of conductivity of Sommerfeld. In the present paper, the author gives a more accurate calculation of the reflection and emission coefficients by correcting for the image field, thus reducing the reflection in an intense field to only a few per cent., and correspondingly increasing the emission. E. E. F. d'A.

1278. Emission of Secondary Electrons from an Aluminium Plate under Illumination. E. Frey. *Helv. Phys. Acta*, 1. 6. *pp.* 385–416, 1928. *In German.*

An aluminium plate not freed from gas is exposed to the total radiation of a mercury amalgam lamp. Under this radiation there is a diminution of the reflected primary electrons. This illumination effect is at first proportional to the secondary current, and then approaches a saturation value, which increases with the luminous intensity. This final value of the illumination effect takes 40 seconds to develop, and 90 seconds to disappear. It is independent of the gas pressure within wide limits. E. E. F. d'A.

1279. Secondary Electron Emission Produced by Positive Cæsium Ions. J. M. Hyatt. *Phys. Rev.* 32. *pp.* 922–928, *Dec.*, 1928.

The source of the positive cæsium ions, a short tungsten filament maintained at about 1200° K. in the presence of cæsium vapour, was mounted on the axis of a long cylindrical grid and plate. The plate current and total positive ion emission current were observed for each of several negative grid potentials as the plate potential was varied from + 50 to − 650 volts. From these observations the number of electrons that were emitted from the cæsium-covered grid and plate per positive ion was calculated. This number increased uniformly from 0·01 at approximately 100 volts to 0·15 at 600 volts. After corrections for the emission of the secondary electrons were made, the ratio of the positive ion current to the plate to the total emission current was found to be independent of the plate and grid potentials for plate potentials greater than 0·2 of the grid potential. This ratio, 0·72, is the same as the ratio between the total area of the plate less the projected area of the grid, and the total plate area. Assuming the same distribution of electrons as positive ions, the ratio of the plate current to the grid current in this type of tube can be calculated. AUTHOR.

1280. Secondary Electron Emission from Molybdenum. J. M. Hyatt and H. A. Smith. *Phys. Rev.* 32. *pp.* 929–935, *Dec.*, 1928.

The secondary electron emission from a very clean molybdenum plate in a simple three-electrode tube has been studied. The number of primary electrons striking the plate was calculated by means of the positive ion calibration method previously reported. The number of secondary electrons per primary reaches a maximum value of 1·15 at 600 volts, and then decreases to 1·00 at 2000 volts. One definite discontinuity in the secondary emission curve occurs at 13·5 volts; the others are very small and are not reproducible. The emission increases about 3 % within a few minutes after heating if the gas pressure is very low, and then remains quite constant for a long period of time. The emission decreases with time when there is more gas present. The secondary emission appears to increase by about 4 % when the temperature of the target increases from the normal operating temperature to 1600° K. AUTHORS.

1281. Thermionic Emission from Clean Platinum. L. A. DuBridge. *Phys. Rev.* 32. *pp.* 961–966, *Dec.*, 1928.

The thermionic emission from thoroughly outgassed platinum in high vacuum has been measured to ½ % over the temperature range 1360 to 1750° K., the temperatures being measured by careful optical pyrometry. The values obtained for the thermionic constants of the T^2 law are, when corrected for the Schottky effect, $b = 72{,}820°$ K, $\phi = 6{\cdot}27$ volts, $A = 17{,}000$ amp./cm.^{2} deg.^{2}. The value of ϕ is possibly in error by not more than 1 % because of uncertainties in the temperature scale, and agrees within ½ % with the value of the photoelectric work function previously obtained. The data confirm the previous announcement that for clean platinum A is 250 times greater than the theoretical value of 60·2 amp./cm.^{2} deg.^{2} [see Abstract 1692 (1928)]. AUTHOR.

1282. Release of Electrons from Atoms by X-Rays. H. Behnken. *Phys. Zeits.* 29. *pp.* 836–837, *Nov.* 15, 1928. *Paper read before the Deut. Naturforscher u. Ärzte, Hamburg, Sept.*, 1928.

The ionising action of the electrons released from a number of elements has been investigated, and the relation to the atomic number studied. The measurements differ from those of Berg and Ellinger in the use of X-rays rendered homogeneous by filtering, and in the fact that the emission from the front side of the plates investigated was measured instead of that from the side on which the X-rays emerged from the plate; in the latter case the rays were altered in intensity and in quality before the electrons observed were released. The electron emission curves show an increase with atomic number, but differ in appearance from those of Berg and Ellinger. A formula has been derived which gives emission curves which resemble the experimental ones. H. N. A.

1283. Experiments on the Diffraction of Electrons. E. Rupp. *Phys. Zeits.* 29. *pp.* 837–839, *Nov.* 15, 1928. *Paper read before the Deut. Naturforscher u. Ärzte, Hamburg, Sept.*, 1928.

Various experiments have been made to prove the wave nature of moving electrons (de Broglie's theory). The author has employed a metal grating with 1300 lines per cm., and grazing incidence. Busch's method of focussing the electron beam on the photographic plate by means of an inhomogeneous magnetic field was employed. The photographs obtained showed the reflected beam, the diffraction image of the first order and often that of the second order, sometimes even that of the third order. By using beams of different velocity it was possible to calculate the value of the grazing angle. For V = 150 volts a wave-length of 1·00 Å ± 0·02 was found for the electron beam. H. N. A.

1284. Ionisation of Carbon Monoxide by Controlled Electron Impact, Interpreted by the Mass Spectrograph. T. R. Hogness and R. W. Harkness. *Phys. Rev.* 32. *pp.* 936–941, *Dec.*, 1928.

By using a mass spectograph previously described, a study is made of the ionisation processes occurring when CO molecules are ionised by electrons of definite energy. The variation of the relative intensities of the ions CO^+, C^+ and O^+ with changes of pressure and with changes of the electric fields has led to the conclusion that the principal processes occurring are: (1) $CO = CO^+ + E^-$; (2) $CO = O^+ + C + E^-$; (3) $CO = C^+ + O + E^-$; (4) $CO + CO^+ = CO_2 + C^+$. No negative or doubly charged positive ions were found. AUTHORS.

1285. Ionisation Processes in Methane Interpreted by the Mass Spectrograph. T. R. Hogness and H. M. Kvalnes. *Phys. Rev.* 32. *pp.* 942–945, *Dec.*, 1928.

The ionisation processes occurring when CH_4 molecules are ionised by controlled electron impact have been determined with the aid of the mass spectograph. CH_4^+ and CH_3^+ are the only ions formed, and by a study of their relative intensities under different conditions of pressure and voltage it was found that both these ions are formed directly by the electron impact. The ionisation processes are: $CH_4 = CH_4^+ + E^-$ (14·5 volts); $CH_4 = CH_3^+ + H + E^-$ (15·5 volts).

It has been definitely determined that besides the two isotopes of neon, Ne_{20} and Ne_{22}, there exists a third isotope with a mass of 21. AUTHORS.

1286. Ionisation of Air by Electrons. W. Schmitz. *Phys. Zeits.* 29. *pp.* 846–849, *Nov.* 15, 1928. *Paper read before the Deut. Naturforscher u. Ärzte, Hamburg, Sept.*, 1928.

Careful measurements were made of the ionisation of air by electrons of velocities ranging from 1000 to 10,000 volts. If v is the mean energy required for the production of an ionic pair the experimental results showed that the value of v was, within the limits of error, constant through the above range of electron velocities. The value found for v was 42 volts. A. W.

1287. Average Life of Ions in Air Over the Sea. V. F. Hess. *Phys. Zeits.* 29. *pp.* 849–852, *Nov.* 15, 1928. *Paper read before the Deut. Naturforscher u. Ärzte, Hamburg, Sept.*, 1928.

Measurements were made at Heligoland in the summer of 1928 of the average life of ions in the air over the sea and of the number of condensation nuclei. The apparatus was installed on the north point of the island at a height of about 50 m. above sea-level. The results showed that when the wind was from N.N.W. or West, thus coming from land-free polar regions, the average life of mobile ions was 200 to 300 seconds, a value four to six times greater than for ions over land. For such polar air also an extremely small value was found for the number of condensation nuclei, namely, 500 to 1500 per c.c., while in the Alps, in the valley of

Gastein, far from human habitations, values were always obtained of 5000 and sometimes as high as 10,000 nuclei per c.c. It appears from these results that Schweidler's recombination law needs extending, since the deviations from it are much too great to be merely accidental. A. W.

1288. Ionisation by Collisions of the Second Kind in Mixtures of Oxygen with the Rare Gases. H. D. Smyth and E. C. G. Stueckelberg. *Phys. Rev.* 32. *pp.* 779–783, *Nov.*, 1928.

Harnwell's experiments on ionisation by collisions of the second kind [see Abstracts 2596 and 2747 (1927)] have been continued. Mixtures of oxygen with argon, neon and helium, and the incidental effects of water vapour have been studies. Evidence of the following collisions of the second kind was obtained:

(1) $A^+ + O_2 \rightarrow O_2^+ + A$.
(2) $A^+ + H_2O \rightarrow H_2O^+ + A$ (very strong).
(3) $H_2O^+ + O_2 \rightarrow O_2^+ + H_2O$.
(4) $Ne^+ + O_2 \rightarrow O^+ + O + Ne$.
(5) $He^+ + O_2 \rightarrow O^+ + O + He$.

The experiments confirm the conclusions of Hogness and Lunn [see Abstract 2175 (1928)] as to the processes of ionisation in oxygen, but leave the exact value of the first ionising potential uncertain. AUTHORS.

1289. Transient Effects with Ions of Low Mobility. H. P. Walmsley. *Manchester Phil. Soc., Mem.* 72. *pp.* 29–41, 1927–1928.

Some effects of altering experimental conditions upon ionisation currents were investigated. It was found that with a variable ionisation the observed currents show a lag with time behind the changes producing them. With mobile ions this effect is negligible, but it is of importance when dealing with ions of very low mobility. Any change which causes a redistribution of such ions in the electric field which is employed to measure the currents produces transient effects which may be comparable in magnitude to the currents measured, and which persist for an appreciable time. A. W.

1290. Effect of Water Vapour on Ionic Mobilities. H. A. Erikson. *Phys. Rev.* 32. *pp.* 791–794, *Nov.*, 1928.

In this paper additional results are given which indicate that an H_2O molecule gives up an electron to the final positive air ion and thus forms an H_2O^+ ion of a greater mobility. Results are also given showing that the reciprocal of the mobility bears a linear relationship to the humidity. [See also Abstract 170 (1928)]. AUTHOR.

1291. Efficiency of Ionisation in Hydrogen by Positive-Ion Impact at 7000 Volts. R. W. Gurney. *Phys. Rev.* 32. *pp.* 795–798, *Nov.*, 1928.

Hydrogen at low pressure is bombarded with potassium positive ions of 7000 volts energy in a tube attached to a positive-ray box. Any hydrogen and scattered potassium ions passing into the latter are distinguished by mass analysis. The applicability of this method for measuring the efficiency of ionisation is discussed. If the hydrogen molecules receive kinetic energy from the 7000-volt ions which ionise them, they will be scattered in all directions, and only those which happen to be projected towards the slit will enter the positive-ray box. But if ionisation is unaccompanied by transfer of kinetic energy, the method is competent to compare the ionising efficiency with that of electron-impact. With small positive-ion emissions no ionisation was detected; with larger emissions a violent discharge took place through the tube. The conclusion reached is that either the ionising efficiency is less than 1/150 of that of 50-volt electrons, or else that ionisation is accompanied by transfer of kinetic energy. AUTHOR.

1292. Ionisation by Electrons in a Homogeneous Electric Field. M. J. Druyvesteyn. *Zeits. f. Physik*, 52. 3–4. *pp.* 197–202, 1928.

The probability of ionisation occurring in one of the rare gases in a homogeneous electric field is calculated. A differential equation of the second order is obtained for the density of the electrons and under certain conditions a closely approximate solution is obtained using Hankel functions. For neon a curve is given for the ionisation probability. [See also Abstract 1506 (1927).] A. W.

1293. Ionisation by Electron Collision. A. v. Hippel. *Ann. d. Physik*, 87. 8. *pp.* 1035–1087, *Dec.* 18, 1928.

In Part I a discussion of the theory of ionisation by electron collision is given based on the classical model and modified by notions of quantum exchanges by analogy with the theory of ionisation by radiation. Part II summarises the previous experimental investigations of collision ionisation in mercury vapour. Part III describes a new experimental method in which a ray of atoms is made to intersect at right angles a ray of electrons, the ions produced by collisions being separated from the atom stream and measured, using a mass spectrograph. Part IV. Preliminary results using the method are given, showing a maximum in the ion yield by collision, for an electron velocity equal to about double the ionisation potential for Hg^+. This result is in accord with the theoretical discussions of Part I; the height of the maximum is also of the right order of magnitude. Part V describes a high-frequency method for the qualitative study of ionisation problems. W. S. S.

1294. Surface Layers on Tungsten and the Activation of Nitrogen by Electron Impact. C. Kenty and L. A. Turner. *Phys. Rev.* 32. *pp.* 799–811, *Nov.*, 1928.

A fine tungsten filament at 400° C. in active nitrogen is quickly covered with a layer which produces a lowering of the filament resistance. This effect appears to be due to heat being more readily conducted from the coated filament than from the clean filament, thus lowering the temperature. The same effect is produced by activating the nitrogen by bombardment with electrons. Traces of oxygen or hydrogen render the filament insensitive to active nitrogen. Results obtained with tubes of small volume containing tungsten discs of large area show that the nitrogen adsorbed is of the order of magnitude required to produce a layer of single atoms. Similar effects with electric arcs in nitrogen are described. A. W.

1295. Detecting Individual Cosmic Rays. W. F. G. Swann. *Frank. Inst., J.* 206. *pp.* 771–778, *Dec.*, 1928.

It is shown that, in view of the enormous energy available for ionisation in a single cosmic ray, and of the relatively small number of ions produced per second by the rays in a vessel of moderate size, the ionisation produced should occur in spurts, which may possibly be observable under suitable conditions. Various difficulties, experimental as well as theoretical, are discussed briefly, and suggestions are made for overcoming some of them. A. W.

1296. Capture of Electrons by Molecules. V. A. Bailey and J. D. McGee. *Phil. Mag.* 6. *pp.* 1073–1089, *Dec.*, 1928.

Gives an account of experiments made with NH_3, using a modification of a method previously employed by Bailey for other gases. In the new instrument the length c of each of the two diffusion chambers can be varied, so that the ratio between the lengths remains constant. This makes it possible to obtain a second equation for the relation between k and α (for the definition of these symbols see following Abstract). The solutions are obtained by graphical methods, and the results of the experiments confirm the theory. The relation between h, the probability of attachment at a collision, and k is considered; as k increases from $5\cdot 5$ to 64 the ratio h/E increases from $0\cdot 6 \times 10^{-3}$ to $8\cdot 1 \times 10^{-3}$ by a factor of about 14; here E is the energy (in volts) lost by an electron at collision with a molecule, $E = 7 \times 10^{-15} W^2$ volts. H. N. A.

1297. Motion of Electrons in Pentane. J. D. McGee and J. C. Jaeger. *Phil. Mag.* 6. *pp.* 1107–1117, *Dec.*, 1928.

The apparatus was that employed by Bailey for other gases [see Abstract 361 (1926)]. The theory is discussed, the method of obtaining the pure gas is described, and the values found for the mean energy of agitation of an electron in terms of the mean energy of agitation of a molecule at 15° C., k, the agitation velocity, V, of the electrons, the mean free path at 1 mm. pressure, L, the fraction of energy lost in a collision, λ, and h, which is equal to $7 (\alpha W^2) \times 10^{-16}/Z$, are given for different values of Z/p, where α is the probability of attachment of an electron to a molecule per unit length of its motion in the direction of the field, W is the drift velocity in the direction of the electric force, and Z is the electric intensity. Curves show how α/p and k vary with Z/p, L with U, W with Z/p and λ with U. There is considerable similarity in all the curves between the two hydrocarbons pentane and ethylene. The λ, U curves show that these two gases and CO_2 are exceptional in possessing a rapid initial rise and a maximum for λ. H. N. A.

1298. Hydrogen Ions as Cause of Occurrence of Photoelectric Selective Effect in Potassium. R. Suhrmann. *Phys. Zeits.* 29. *pp.* 811–815, *Nov.* 15, 1928.

Carefully purified and dry hydrogen causes no increase in the photoelectric sensitivity of potassium. The influence of hydrogen in various states of activation has been investigated by first activating the hydrogen by electron collision. It is found that the selective maximum at 440 $\mu\mu$ is produced in the presence of positive hydrogen ions. It is suggested that the hydrogen ion forms a very unstable and highly deformed molecule of potassium hydride at the metal surface. F. J. W.

1299. Photoelectrons Produced by X-Rays. E. J. Williams, J. M. Nuttall and H. S. Barlow. *Roy. Soc., Proc.* 121. *pp.* 611–625, *Dec.* 3, 1928.

A survey is given of previous observations on the longitudinal asymmetry and dispersion of the photoelectron distribution produced by X-rays, with reference to the requirements of modern theory. The possible sources of error which may explain the discordant results of previous observers are discussed, and the precautions taken to eliminate them in the present investigation are described. This paper refers to the photoelectron emission from oxygen and nitrogen due to the absorption of X-rays of wave-lengths 0·54, 0·61 and 0·71 Å respectively. Shows that the spread or dispersion of the photoelectrons may be satisfactorily represented by the $\cos^2\theta$ law, and that the longitudinal asymmetry of the distribution corresponds to an average forward momentum of the photoelectrons nearly 40 per cent. greater than that of an absorbed quantum. E. E. F. d'A.

1300. Theory of the Photoelectric Effect. H. T. Wolff. *Zeits. f. Physik*, 52. 3–4. *pp*. 158–160, 1928.

Points out the difficulties which arise if the conduction electrons are held directly responsible for the photoelectric effect at optical frequencies, and suggests that the emission process is indirect—a free electron receiving energy by a collision of the second kind with an atom which has been excited by the incident light. H. R. R.

1301. Normal Photoelectric Effect in Metals. P. Lukirsky and S. Priležaev. *Zeits. f. Physik*. 49. 3–4. *pp*. 236–258, 1928.

The normal photoelectric effect is determined in Al, Zn, Sn, Ni, Ag, Cd, Pb, Cu, and Pt, the metals being exposed to the mercury lines 2302, 2400, 2537, 2653, 2802, 2967, 3022, and 3130 Å. The values of the maximum velocities are used for a re-determination of Planck's constant *h*. The mean value comes out as $6 \cdot 543 \times 10^{-37}$ erg. sec. There is also a satisfactory relation between the limits of excitation and the contact potentials. The smaller the thickness of the metal, the more monochromatic are the velocities of the photoelectrons, and the closer do they approach the maximum velocities. E. E. F. d'A.

1302. Critical Photoelectric Potential of Clean Mercury. W. B. Hales. *Phys. Rev*. 32. *pp*. 950–960, *Dec*., 1928.

Reconstructs the Kazda-Dunn apparatus with special precautions for securing clean mercury. With the new apparatus the long-wave limit for running mercury is found to be 2735 Å. Impurities raise the threshold to 2850 Å. Oxygen has a decided reducing effect upon the threshold value, bringing it down to 2555 Å in 18 hours. E. E. F. d'A.

1303. Electromagnetic Waves—Nature of Electronic Scattering during the Propagation of Short Waves. Ponte and Y. Rocard. *Comptes Rendus*, 187. *pp*. 942–943, *Nov*. 19, 1928.

It is suggested that the results of Ekersley on the scattering of short waves by the Heaviside layer may be explained if it is assumed that the electrons exist in the form of "clusters" of a size small compared with the wave-length. Applying to such an assembly the equations of Bragg for the interference of X-rays by reflection at a crystal surface, the magnitude of the regions in which only weak signals can be received is calculated.

F. J. W.

1304. Generation of Short Electric Waves by the Method of Barkhausen and Kurz. F. Tank and E. Schiltknecht. *Helv. Phys. Acta*, 1. 2. *pp*. 110–138, 1928. *In German*.

An experimental investigation was made of the method of Barkhausen and Kurz for the generation of short electric waves and the results are used as basis for a theory of the method. The oscillation phenomena depend on a control effect of the oscillating space charges on the space-charge density of the emission current, which latter must, therefore, have reached its saturation value. The effect of the external circuit, coupling effects, harmonic oscillations and the behaviour in a magnetic field are also dealt with. A. W.

1305. Damping and Oscillation Excitation of Aperiodic Systems. F. Tank and K. Graf. *Helv. Phys. Acta*, 1. 7–8. *pp.* 508–517, 1928. *In German.*

Circuits containing only resistance and inductance, or resistance and capacity, when suitably connected and coupled together through any type of amplifier, can be made to generate oscillations. The authors theoretically consider the cases where the amplifier is a transformer, a four-electrode valve in a tetrode multivibrator and a three-electrode valve in Abraham and Bloch's multivibrator. It is shown that in every case the oscillations have the character of natural vibrations which are connected with the stability of the electrical system. With sufficiently small amplitudes the oscillations are sinusoidal, whilst with larger amplitudes, when the amplifier resistance can no longer be considered constant, important distortions at first occur. R. C. F.

1306. Velocity of Propagation of Electric Waves in Thin Wires. L. Bergmann and G. Holzlöhner. *Ann. d. Physik*, 87. 5. *pp.* 653–676, *Nov.* 1, 1928.

Experiments were made on the propagation of electric waves along wires of copper, aluminium, brass, German silver, manganin and constantan of 0·04 to 0·3 mm. diameter. Two tube-senders of wave-lengths of 172 and 400 cm. were used as generators. Values for the differences of the wave-lengths in these wires and in copper wires of 1·5 mm. diameter were obtained. These differences, which are given in tables, may be regarded as in agreement with the theory, especially as in this theory infinitely long conductors, ideal cylindrical surface of conductor, no disturbance by the surroundings, and so on, are supposed, which are actually never realised in practice. J. J. S.

1307. Temperature Coefficient of Quartz Crystal Oscillators. R. S. Strout. *Phys. Rev.* 32. *pp.* 829–831, *Nov.*, 1928.

The change of frequency with temperature of a quartz crystal plate 1·8 × 1·8 × 0·11 cm., vibrating in a direction normal to its faces with a frequency of 2700 kilo-cycles, was determined at various temperatures. A second oscillating plate was used as a fixed frequency, while the heterodyne note was heard with a receiving set. This second plate was maintained at, or near, room-temperature, and was reground to an appropriate frequency for each determintaion. The temperature coefficient of frequency was found to decrease linearly from 22·7 parts per million per degree at 65° C. to 1·6 parts per million per degree at — 189° C. AUTHOR.

1308. Constants of the Equivalent Electrical Circuit of a Quartz Resonator. P. Vigoureux. *Phil. Mag.* 6. *pp.* 1140–1153, *Dec.*, 1928.

The case is considered in which a difference of potential is applied to the faces of a parallelepiped of low temperature quartz by means of two metal plates placed close to the faces and connected to the terminals of a condenser of an oscillating circuit tuned approximately to one of the natural frequencies of the quartz, the coil of the oscillatory circuit being loosely coupled to the output coil of a valve generator. As the frequency of the generator passes through the natural frequency of the quartz, the quartz vibrates strongly and reacts on the oscillatory circuit, causing a diminution of current in the coil. The object of the paper is to show how the effective inductance and the effective capacity in the circuit can be estimated from the dimensions of the quartz, its modulus of elasticity and its piezoelectric constant; and a mathematical discussion is given, a simpler case being first dealt with by working out expressions for a thin bar. An important result is deduced from the analysis, concerning the strain at any point in the vibrating rod. The displacement is sinusoidal, being zero at the centre and a maximum at the ends, and the strain is a maximum at the centre and decreases to zero at the ends. J. J. S.

ELECTRICAL PROPERTIES AND INSTRUMENTS.

1309. Electrical Conductivity of Dilute Liquid Amalgams of Gold and Copper at Various Temperatures. T. C. Williams and E. J. Evans. *Phil. Mag.* 6. *pp.* 1231–1253, *Dec.*, 1928.

This is a continuation of the work of Johns and Evans on the electrical conductivities of the amalgams of the metals of group I (*b*) of the periodic table [see Abstract 1381 (1928)]. Determinations are made of the conductivities of gold and copper amalgams of various concentrations at temperatures up to 300° C. The results are compared with Skaupy's theory of conduction in metallic solutions [see Abstract 740 (1921)]. Resistivities are measured with the aid of a Callander-Griffiths bridge, the amalgams being in the form of a cylindrical column enclosed in a fine capillary tube. Precautions are taken to avoid errors due to thermoelectric currents, air bubbles, and variable contact resistance. The results are given in tables and graphs. It is shown that, conformably with Skaupy's theory, the effect of copper, silver, and gold, atom for atom, on the conductivity of mercury is the same, provided the concentration is small. T. B.

1310. Effect of Moist Air on Resistance of Pencil Lines. J. B. Seth, C. Anand and G. Chand. *Phys. Soc., Proc.* 41. *pp.* 29–34; *Disc.*, 34–35, *Dec.*, 1928.

The resistance of a pencil line is found to increase when it is kept in a moist atmosphere. The change in resistance for different degrees of moisture is investigated, and a suggestion is made that this change may, in certain circumstances, be utilised to measure humidity. AUTHORS.

1311. Hall Effect and Magnetic Induction in a Bar of Electrolytic Iron. E. M. Pugh. *Phys. Rev.* 32. *pp.* 824–828, *Nov.*, 1928.

The material was a bar forged out of electrolytic iron to which 0·2 % of Mn had been added, and the method of observation enabled the simultaneous measurement of the magnetic induction B and the Hall e.m.f. E. E increases linearly with B up to 12,000 gauss, at which value the permeability is a maximum. The Hall coefficient R was found from E = RB*ib*, where *i* is the current density and *b* is the width of the strip in the direction in which E is measured. The Hall coefficient found, *viz.*, 0·0055 abs. e.m.u., is of the same order of magnitude in the bar as in thin sheets, provided that B is used in the calculation instead of the field H. G. E. A.

1312. Hall Effect in Galena and Molybdenite. C. W. Heaps. *Phil. Mag.* 6. *pp.* 1283–1286, *Dec.*, 1928.

Galena and molybdenite crystals exhibit a very large Hall effect. In the cubic crystals of galena the magnitude of the Hall coefficient appears to be independent of the orientation of crystal axes. Impurities seem to exert a very great influence on the Hall effect in lead sulphide. The difference between the adiabatic and the isothermal Hall effects appears to be small in these minerals. J. J. S.

1313. Volta Effect in Air and Damp Superficial Pellicles. R. Deaglio. *Accad. Lincei, Atti,* 8. *pp.* 60–63, *July,* 1928.

Dampness of the superficial pellicles, necessary for the Pila effect, has no sensible influence on the Volta effect. A. D.

1314. Electric Moment and Its Relation to Chemical Constitution. P. C. Mahanti and D. N. Sen Gupta. *Indian Journ. Phys.* 3. *pp.* 181–196, *Nov.* 30, 1928.

Previous work is first referred to [see Gans, Abstract 1301 (1921)], the paper itself dealing with the determination of the permanent dipole moments and polarisability of the organic halides CH_3I, C_2H_5Br and C_2H_5I by the heterodyne beat method. It is found that $\mu = 1 \cdot 31 \times 10^{-18}$ e.s.u. for CH_3I, $1 \cdot 78 \times 10^{-18}$ for C_2H_5Br and $1 \cdot 62 \times 10^{-18}$ for C_2H_5I; their polarisabilities are 0·005761, 0·002200 and 0·007839 respectively. The dipole moment thus gradually weakens with increasing atomic weight of the halogens. It is suggested that the permanent dipole moment in compounds of this type is due to the deformation of the electron orbits of carbon and halogen which give rise to the permanent moment of the molecule, and that the polarisability of the molecule itself due to applied field increases with the increasing atomic weight of the halogen due to the weakening of the bond of the shared electron. H. H. Ho.

1315. Electric Moments of CH_3Cl, C_2H_5Cl and $CHCl_3$. S. C. Sircar. *Indian Journ. Phys.* 3. *pp.* 197–208, *Nov.* 30, 1928.

The paper describes measurements of the dielectric constants of CH_3Cl, C_2H_5Cl and $CHCl_3$ vapours at different temperatures by the heterodyne null method [see also Abstract 2760 (1927)]. The results entirely support Debye's dipole theory, the values of the permanent moments calculated on the basis of this theory being $1 \cdot 69 \times 10^{-18}$ for $CHCl_3$, $1 \cdot 98 \times 10^{-18}$ for C_2H_5Cl and $1 \cdot 05 \times 10^{-18}$ for $CHCl_3$ (all in e.s.u.). These values are compared with those obtained from optical data, and with the results of other workers. H. H. Ho.

1316. Dependence of the Dielectric Constant of Liquid Helium on the Temperature. M. Wolfke and W. H. Keesom. *K. Akad. Amsterdam, Proc.* 31. 7. *pp.* 800–806, 1928. *Comm. No.* 192*a from the Phys. Lab. Leiden.*

The authors have previously found that the dielectric constant shows a jump at about 2·3° K., and that there are two different modifications of liquid helium. Gives details of new measurements, in which a specially designed stirrer was employed in the apparatus previously used. The electrical arrangements were improved, and values of the dielectric constant are tabulated for temperatures between 4·19° K. and 2·04° K.; the curve plotted for these values shows the jump at 2·295° K., vapour pressure 38·65 mm.; this fixes the triple point for liquid helium I, liquid helium II and vapour. The electric polarisation is constant to the first approximation, and has the same value for the two modifications; it is probable that the helium molecule as such does not undergo any change in internal structure at the transformation point. The polarisation of gaseous helium has been calculated from the refractive index for infinitely long waves and the density, the value is about 4 per cent. larger than that obtained by the authors for liquid helium. The value of the dielectric constant of gaseous helium at the boiling point, calculated from the above value of the polarisation, differs only by 0·14 % from the value obtained by Wolfke and Kamerlingh Onnes; it appears then that the molecule remains the same in passing from the gaseous to the liquid state. H. N. A.

1317. Dielectric Cohesion of Inert Gases. M. Curie and A. Lepape. *Comptes Rendus*, 187. *pp*. 1283–1285, *Dec*. 26, 1928.

Bouty (numerous papers from 1899–1921) introduced the idea of dielectric cohesion into the study of electrical conduction in gases and published data for helium, neon and argon. These measurements have now been repeated under different conditions of electric field and the investigation completed by the study of krypton and xenon. Modifications of Bouty's experimental method are described, together with precautions for securing the purity of the gases. Neon appears to possess the minimum dielectric cohesion, but for comparison purposes helium is excluded on account of the peculiar structure of its atom. In the series Ne, Ar, Kr, Xe, the dielectric cohesion increases with the atomic number, whilst the ionisation potential decreases. A possible explanation is included. H. H. Ho.

1318. Anomalous Dispersion, Absorption and Kerr Effect in Viscous Dielectrics. D. W. Kitchin and H. Müller. *Phys. Rev*. 32. *pp*. 979–987, *Dec*., 1928.

The temperature variation of the dielectric constant and power factor of castor oil and rosin, measured at different frequencies from 10^7 to 60 cycles, shows that, in accordance with Debye's theory of polar molecules, the region of anomalous dispersion of these very viscous liquids shifts with decreasing temperatures into the long-wave radio region and even down to audio frequencies. The measurements qualitatively verify the theory. The influence of viscosity in solutions of rosin in different oils which have no polar molecules is found in agreement with the theory. The existence of anomalous dispersion in the audio and radio frequency region explains the complicated dielectric behaviour of many insulation materials and makes it possible to observe an anomalous behaviour of the Kerr effect, or electric double refraction. According to Debye, this effect is due to the orientation of the molecules and should disappear at temperatures and frequencies where the orientation of the dipoles is impossible. We find, as is to be expected, that the regions of anomalous Kerr effect and of anomalous dispersion coincide. AUTHORS.

1319. Thermoelectric Phenomena. K. Kämmerer. *Ann. d. Physik*, 87. 7. *pp*. 948–958, *Dec*. 8, 1928.

A mathematical discussion of thermoelectric behaviour by means of the temperature-entropy diagram. J. J. S.

1320. Compensation Method of Measuring Small Currents. R. Jaeger. *Zeits. f. Physik*, 52. 9–10. *pp.* 627–636, 1928. *From the Reichsanstalt.*

A description of a modification of the uranium oxide standard used in the Siemens dosimeter whereby the ionisation currents may be measured directly in amperes. A kind of Bronson resistance is made by covering the plates of a cylindrical condenser with uranium oxide and arranging a shielding system so that the area of radioactive substance exposed at a given time may be varied down to zero. In this way a very small ionisation current of variable magnitude is obtained. This current is allowed to flow through a high resistance and the difference of potential produced measured electrostatically, while the current through, say, the ionisation chamber of the dosimeter is allowed to flow through the resistance in the opposite direction the curent in the radioactive circuit being so adjusted that the electrometer shows no deflection. In practice the difference in potential produced is led on to the grid of a valve of special construction and a more robust current measuring instrument employed. A detailed description is given of the application of the variable current standard to the Siemens dosimeter in particular. A very simple arrangement for the measurement of small currents is obtained by arranging an electrometer of small capacity so that it is deflected either to one direction or the other according as the current is too large or too small in the variable resistance circuit. The unknown current may then be read directly without a knowledge of the sensitivity or capacity of the electrometer. An example is given showing the high accuracy obtainable. W. V. M.

1321. Mutual Inductance and Torque between Two Concentric Solenoids. C. Snow. *Dept. of Commerce, Bureau of Standards, Research Paper No.* 24. *pp.* 685–699, 1928.

By integrating a form of expression for the magnetic field due to a circular current an expression involving zonal harmonics is obtained for the r component of the magnetic field within a solenoid, where r is the radius vector from an origin lying on the axis of the solenoid. Hence is obtained the flux of this field through a circular element perpendicular to r, and thence by integration the mutual inductance of the two solenoids is obtained in a rapidly converging series. The axes of the solenoids made an angle θ, and by differentiating with respect to this angle the torque between the two is obtained when each carries an electric current. Correction terms are obtained for the effect of the discrete nature of the windings of both solenoids. J. J. S.

1322. Derivation of Inductance Formulæ. F. W. Grover. *Dept. of Commerce, Bureau of Standards, Research Paper No.* 16. *pp.* 487–511, 1928.

This paper gives a classification of existing inductance formulæ for coaxial circles and single-layer solenoids, and discusses the possibility of additional formulæ of each class. A number of new formulæ are developed which can be used to advantage for certain cases. Still other formulæ could be obtained, but on account of complexity or poor convergence they are not likely to be useful. It is shown by means of numerical examples that the inductance in any given case can be calculated by more than one formula and to a degree or precision far beyond practical requirements. AUTHOR.

1323. Design of Valve Voltmeter. W. F. Powers and G. W. Alderman. *J.O.S.A. and R.S.* I. 17. pp. 379–380, *Nov.*, 1928.

Describes an arrangement of apparatus to give valve voltmeters of the type of van der Bijl, Moullin, Kirke and Dowling. No originality is claimed for the method, but it is stated that the arrangement is of value since it " does not mean costly apparatus " and has a wide application.

G. E. B.

ALTERNATING CURRENTS AND MAGNETISM.

1324. Magnetic Susceptibility of Ozone. V. I. Vaidyanathan. *Indian Journ. Phys.* 3. *pp.* 151–163, *Nov* 30, 1928.

A test rod was suspended by a glass fibre in a gaseous mixture of oxygen with about 7 % of ozone. Retorsion of the suspended system in the magnetic field was adopted, and the contribution of the ozone to the magnetic effect was deduced. In all cases the magnetic force on the mixture was less than that on pure oxygen. Applying the method of statistical probability of errors, the ozone appears to be diamagnetic. This agrees with Wulf's conclusion. [See Abstract 1053 (1928).]

G. E. A.

1325. Diamagnetism and Structure of Ethylene. V. I. Vaidyanathan. *Indian Journ. Phys.* 3. *pp.* 165–174, *Nov.* 30, 1928.

Using a torsion method [see Abstract 1721 (1928)] the molecular magnetic susceptibility of ethylene, a substance previously supposed to be paramagnetic, is found to be diamagnetic with the value $-15\cdot3 \times 10^{-6}$. This is in fair accord with Pascal's law, and agrees with that of sulphur with the same number of electrons. The structure of the molecule is discussed from the magnetic and chemical standpoints. G. E. A.

1326. Magnetostriction in Iron Crystals. N. Akulov. *Zeits. f. Physik*, 52. 5. 6. *pp.* 389–405, 1928.

The author has calculated the magnetostriction in iron crystals for various directions of the external field relative to the crystalline axes, from general formulæ for the energy of expansion and of electro- and magnetostriction of a dipole lattice. The curves derived from the formulæ agree well with those found by experiment [see Abstract 1889 (1927)]. The conclusions are drawn that iron ions possess no perceptible electric dipole moment, and that, as regards the mutual magnetic action of these ions, they may, to a first approximation, be treated as simple magnetic dipoles. G. E. A.

1327. Absence of Effect of an Electric Field on the Magnetic Susceptibilities of HCl and NO. L. M. Mott-Smith. *Phys. Rev.* 32. *pp.* 817–823, *Nov.*, 1928.

The susceptibilities of the two gases were measured in directions parallel and perpendicular to the electric field, and in all cases their values remained unchanged, although elementary theory indicates that a 13 % change in volume susceptibility may be expected. G. E. A.

1328. Ferromagnetic Ferric Oxide. E. F. Herroun and E. Wilson. *Phys. Soc., Proc.* 41. *pp.* 100–111; *Disc.*, 111, *Dec.*, 1928.

A brief account is given of work relating to the above subject that has been published during the past eight years. The authors confirm the observation by Sosman and Posnjak that lepidocrocite, but not göthite, yields on dehydration a strongly ferromagnetic ferric oxide. As all the speciments of lepidocrocite examined contained 3 % or 4 % of manganese oxide, they suggest that this substance may be an essential constituent of this crystalline form of the hydrate. They find that the temperature at which the ferromagnetic oxide is permanently transformed into the common paramagnetic kind is largely dependent upon its mode of preparation. A table showing the magnetic force at which the magnetic permeability and susceptibility reach their maximum values as well as the coercive force and remanent magnetisation is given for different kinds of magnetic ferric oxide and for magnesium and copper ferrites in the form of compressed rectangular bars. Comparative figures are given for two varieties of natural magnetite. Curves are also given showing the variation of permeability with field strengths ranging from 25 to 1300 c.g.s. units. Although copper ferrite has a higher maximum permeability than ordinary precipitated magnetic oxide of iron, it falls far below that of the purer forms of native magnetite. Analyses of several natural magnetites are given, and the high or low values of the susceptibility of the ferric oxide resulting from their oxidation are attributed to the presence or absence of impurities, particularly magnesia, which forms a magnetic ferrite.

AUTHORS.

1329. Magnetic Declination at Kew Observatory, 1859-1894. C. Chree. *Meteorolog. Office, Geophys. Mem.* 5. *No.* 43. [33 *pp.*], 1928.

RADIOGRAPHY AND ELECTROPHYSIOLOGY.

1330. Metal X-Ray Tube with Complete Protection and Earthed at One End. R. Thaller. *Zeits. f. techn. Physik*, 9. 12. *pp.* 500-501, 1928. *Paper read before the Deut. Naturfoscher u. Ärzte, Hamburg, Sept.*, 1928.

A description of a hot kathode X-ray tube consisting very largely of a very long vaccum tight metal tube, which is earthed and carries the positive pole of the tube (the anode). This tube has a diameter of 7 cm., and is 80-100 cm. long, and serves also to protect from stray radiation. The anti-kathode is a tungsten button in copper, and the rays proceed perpendicular to the axis of the tube. The kathode is insulated from the anode by means of a long glass tube, virtually a prolongation of the metal one, the length of this glass portion depending on the maximum voltage to be used. The metal tube is of copper, 2 mm. thick, and the anode is directly water-cooled from the main water supply, since, of course, it is earthed. The patient may be brought very near the target, and, hence, large intensities obtained on the skin. W. V. M.

1331. Protection in the Manufacture of X-Ray Tubes. H. Pilon. *Soc. Franç. Élect., Bull.* 8. *pp.* 1137-1145, *Nov.*, 1928.

An interesting description of the measures taken to avoid irradiation of and injury to those engaged in making X-ray tubes. These are three main dangers: (1) that due to irradiations by X-rays—dermatitis, pernicious anæmia, etc.; (2) that due to high tension; (3) that due to accessory causes, such as injury to the eyes from the glare of the incandescent electrodes. With respect to the first class, the danger arises during the evacuation, and is met by enclosing the tubes in lead-shielded boxes. The dangers of high tension are minimised by the provision of light signals, which show when the high voltage is in use, and the presence of barriers, which cannot be moved without automatically breaking the primary circuit. Special circuit-breakers are in use. The eyes of the operatives are protected by the use of coloured glass, while the moving of heavy protecting screens may be easily carried out by judicious counterbalancing of the lead. The ventilation, etc., of the factory receive careful attention. A cinematograph film of an educational nature helps considerably in the more effective use of the means of protection provided. W. V. M.

1332. Present State of the Radiological Units. A. Dauvillier. *Soc. Franç. Élect., Bull.* 8. *pp.* 1113–1124, *Nov.*, 1928.

A discussion of the considerations and conclusions of the International Committee which met in July 1928 in Stockholm to settle the question of an international unit of X-ray dose. Three main lines of proposals were put forward: (1) To use a small exploring chamber with effective "air" walls and calibrate with the γ-rays of radium. (2) To use a standard large air chamber to calibrate small chambers in an electrostatic unit. (3) To use the second type of chamber, but calibrate in a c.g.s. unit of energy, considering the absorption in unit volume of water. The first type fails in that it would not be comparable over a very wide range of X-rays, is not suitable for use with very soft rays, the unit would depend on a particular type of chamber (a rather inconvenient one, moreover), the difference in type of ionisation produced by γ-rays and X-rays, while the ionisation currents obtained depend on the precise distribution of the radium. The unit adopted (the "*r*" unit) is of the second type, the wall being the amount of X-radiations producing (at 0° C. and a pressure of 76 cm. of Hg) such a degree of conductivity that one electrostatic unit of charge is measured at saturation current, the secondary electrons being completely employed and wall effects in the chamber avoided. The writer then discusses the details of construction of the standard chamber used by him. The volume of air ionised is obtained by multiplication of the area of the diaphragm and the length of the central electrode; the current being measured with a sensitive galvanometer. The unit which is most desirable is, however, the absolute c.g.s. one, the erg per cubic centimetre per second, and it is easy to transfer from the *r* unit to the absolute c.g.s. one. Thus, the work done in producing a pair of ions may be considered as 35 volts. Hence:

w = power absorbed in 1 c.c. of water $= \frac{iC}{10e} \cdot \frac{pe}{300} . k(c = 3 \times 10^{10}$ cm./sec., e = charge on the electron, i = current, ρ = ionisation potential for air, k is the ratio of the absorptions for air and water (= 820 actually);

$$w = 28 \cdot 7 \times 10^{10} i \text{ erg/sec./cm.}^3 \text{ water};$$

but $$1r = 3 \cdot 10^9 i \times \text{sec.}; \quad 1r = 95 \cdot 67 \text{ ergs/cm.}^3 \text{ water}.$$

The paper concludes with a calculation showing that for soft rays (6–8 Å.) the erythema dose corresponds to 1115 ergs/cm.^{2}, and for penetrating rays varies from 30,000 to 10,000 ergs/cm.^{2}. W. V. M.

1333. Transforming and Rectifying X-Ray Set. *Engineering*, 126. *pp.* 770–771, *Dec.* 21, 1928.

A description of an X-ray set constructed by the Solus Electrical

Company, London. The set includes three single-phase transformers, with their secondaries connected in star and having two hot kathode rectifying valves in each phase to give full wave rectification, so that in use on a 3-phase, 4-wire system the minimum voltage is never less than 86 % of the maximum on the tube. The three pairs of valves are mounted above the transformers, one valve in each pair having its filament at the bottom and the other at the top. The three lower filaments are heated by currents from separate transformers, but since the other three are all at the same potential the transformers supplying them can be accommodated in a single tank with only one high-tension insulator. A 3-phase induction regulator is provided on the primaries of the main transformers to control the voltage applied to the latter, the regulator being of the induction motor type. Arrangement is made for a foot switch system, which enables the operator to pass directly from screening to radiographic currents and voltages. The apparatus is capable of giving a maximum pressure of 120 kV, and supplying a momentary current of 300 mA at 60 kV. W. V. M.

1334. Difference between the Radiological Unit R Used in Europe and North America. F. Vierheller. *Univ. Nac. La Plata, Estudio Ciencias, No.* 86. *pp.* 347–358, *Nov.*, 1928.

(1) The German R unit of Glasser used in the U.S.A. is only applicable to the primary X-radiation. (2) The German R unit of Behnken, of Berlin, is only applicable to the secondary X-radiation, *i.e.*, to the effective wave-length of the scattered radiation. (3) To obtain the particular biological effect the units of both authors are in agreement when both the primary and secondary radiations are considered, *i.e.*, the effective wave-length of the total radiation. (4) There is a definite relationship between the biological effects and the applied wave-length, but this relationship is not yet determined, as the difference between the secondary radiations is too small. (5) The relationship between the R units of Glasser and Behnken is expressed by a relation given by the present author. B. J. L.

1335. Properties of Rays of 4-8 Å. J. Saidman and R. Cahen. *Comptes Rendus*, 187. *pp.* 1000–1002, *Nov.* 26, 1928.

Reference is made to the previous work of Saidman [see Abstract 745 (1928)] upon the biological action of short X-rays of wave-length 8 Å. These were carried out with a Dauvillier tube. Holweck using a different type of tube with a cellophane window has attributed the biological effects to rays of 4 Å. rather than 8 Å. The present authors have made further experiments with the Dauvillier tube, equipped with a cellophane window, with reference to the production of an erythema upon the skin of the human shoulder, and upon various diseased skin conditions, as psoriasis, eczema, etc. They conclude that the most rapid and beneficial biological action is due to the rays between 6–8 Å., and the actions due to shorter rays are more analogous to the effects of X-rays of normal wave-length.

B. J. L.

1336. Measurement of Dosage of Kathode Rays with High Power Lenard Tubes. R. Thaller. *Phys. Zeits.* 29. *pp.* 841–846, *Nov.* 15, 1928. *Paper read before the Deut. Naturforscher u. Ärzte, Hamburg, Sept.*, 1928.

Brief reference is made to the development of physical and biological intensity measurements in light and X-ray therapy. This is followed by a review of the development of kathode-ray excitation since Lenard's original discovery. A description is then given of a Lenard tube used by the author. This differs, chiefly as regards construction, from the high-power tube used by Coolidge in 1925 [see Abstracts 390 (1926) and 1165, 1166 (1927)], by variation of the tube form and construction of the metallic foil window *via* which electrons are emitted to the exterior. This tube is in permanent connection with the evacuating pump and is operated by transformer apparatus capable of giving 350 kV and built upon the Dessauer principle. One pole of the transformer system is earthed and is in communication with the tube window, which is therefore likewise earthed. At 200 kV kathode rays are emitted, having a range of 50–55 cm. in air at atmospheric pressure. To measure the intensity of emission a paraffin or collodium condenser arrangement is used and the leakage current across the plates of the condenser, when subjected to kathode rays, is measured by a milliamperemeter. This apparatus is illustrated but not described in detail. Curves are given showing the variation of the leakage current with distance of the instrument from the tube window and with variation of the current intensity *via* the tube. B. J. L.

1337. Radiological Exhibition. E. H. W. Banner. *El. Rev.* 103. *pp.* 927–928, *Nov.* 30, *and pp.* 971–973, *Dec.* 7, 1928.

A useful survey of the general trend of development of X-ray sets during the last few years, more particularly the high-tension apparatus. The paper contains descriptions of a variety of X-ray plants exhibited at the Exhibition. W. V. M.

1338. Production of a Rectangular Wave-Form for Research Work on Chronaxy. P. Fabre. *Comptes Rendus,* 187. *pp.* 849–852, *Nov.* 5, 1928.

An arrangement of triode valves is described and illustrated which supplies a current of rectangular wave-form to a subject or specimen for which the chronaxy is being determined in physiological experiments. The mathematical theory is briefly considered and reference is made to previous papers [see Abstracts 3125 and 3126 (1928)]. B. J. L.

1339. Geometry of Cross-Beam Radiation. J. van Roojen. *Brit. J. of Radiology,* 1. *pp.* 378–389, *Oct.,* 1928.

A theoretical discussion of the problem of "cross-fire" methods in X-ray treatment. W. V. M.

1340. Practical Applications of Geometric Principles in Cross-Beam Radiation. J. van Roojen. *Brit. J. of Radiology,* 1. *pp.* 454–466, *Dec.,* 1928.

The present paper contains a description of the application of the theoretical principle deduced in the earlier paper [see preceding Abstract]. There it was shown theoretically that in the cross-beam treatment one must be guided by certain rules, such as the fact that the crossing cones must envelop the regions to be treated as closely as feasible, there must be no redundancy of cones, the depth to the centre of the volume to be moderated should be the same for the cose of each cone, compression ought to be applied simultaneously from all ports of entry, wherever feasible a tetrahedron arrangement and if possible a regular tetrahedron is to be preferred. In practice, the simplest way is to consider the region to be treated geometrically as enveloped by a sphere and the body built up to comply with this consideration as nearly as possible in practice. The paper then describes a tetrahedron compressor, which in its simplest form consists of four cylindrical tubes which can be rigidly held by means of strong metallic hoops in such a position that their axes pass through one given centre and through the vertices of a regular tetrahedron. The compressor tubes have a shallow concavity towards the part to be compressed. Hohlfelder uses compressors with the convexity towards the part to be compressed in order to increase the intensity near the periphery of the beam. The author considers that actually just the opposite effect would be obtained. In practice the use of either concave or convex compressors is, of course, limited. A diagram and fairly detailed description is given of a pelvic treatment in which the tetrahedral compressor may be used. The paper concludes with a description of a treatment of the head in which the tatragonal arrangement is used merely as a beam arranger. Careful wax moulds of the part to be irradiated are first made. The compressor is then fitted, the spaces between the tubes and the part to be treated are filled in with clay and a plaster mould made of the clay. With this mould a cast of wax is made which now exactly fits on to the part to be treated, and has four regular surfaces which are to serve as ports of entry for the crossing beams. The actual compressor need not be used in the actual treatment, as it is only necessary to see that the beams are properly directed on the regular surfaces of the cast. The author maintains that in this way the cross-fire method may be made much more accurate and a definite improvement in results should follow. W. V. M.

1341. Slide Rule for Radon Dosage Calculations. W. V. Mayneord. *Brit. J. of Radiology*, 1. *pp*. 467–470, *Dec.*, 1928.

To avoid the necessity of intricate calculations of milligramme-hours of dosage, when using "Radon" seeds for therapeutic purposes, Ransom described the use of a special slide rule. The present author describes and illustrates the scales of a slide rule for a similar purpose which is used at the Cancer Hospital. B. J. L.

1342. Application of Nernst's Law to the Excitation of the Depressor Action of Nerves. P. Lasareff and P. Pavlov. *Zeits. f. Physik*, 51. 11–12. *pp*. 842–843, 1928.

Nernst has shown a relationship $\frac{a}{\sqrt{N}} = K =$ constant for motor and sensitory nerves, where a is the amplitude of the excitatory current and N the periodicity of this current. Lasareff [see Abstract 464 (1928)] has shown, when N is greater than 50,000, that this relationship no longer holds, and is replaced by $\frac{a}{N} =$ constant. The present authors investigate this relationship for depressor or inhibitory nerves, utilising the action of the frog's vagus nerve upon the heart. They find that the Lasareff law holds for values of N between 50,000 to 350,000. B. J. L.

CHEMICAL PHYSICS AND ELECTROCHEMISTRY.

1343. Adsorption of Iodine on Calcium Fluoride. J. H. de Boer. *K. Akad. Amsterdam, Proc.* 31. 8. *pp.* 906–914, 1928.

The adsorption of iodine by calcium fluoride was studied as an example of the methods used to prevent the blackening of the walls of the bulb of metal filament electric lamps. This trouble is usually counteracted by introducing some salt into the bulb. The theory of the adsorption was discussed from the standpoint of polarisable atoms. The determinations were made in a bulb into which a filament was sealed. The bulb opposite the filament was coated with calcium fluoride. The bottom of the bulb was drawn to a narrow tube to contain the solid iodine. The coated portion of the bulb was kept at room-temperature, and the iodine warmed. The iodine deposited on the calcium fluoride layer appeared as a brown transparent layer. The quantity was determined analytically. Graphs show the relationship between the iodine adsorbed and the pressures of the iodine vapour. F. J. B.

1344. Adsorption of Methylene Blue by Gelatin; Kataphoretic and Spectrometric Experiments. A. Fodor and K. Mayer. *Kolloid Zeits.* 46. *pp.* 201–207, *Nov.*, 1928.

Methylene blue chloride alone, in concentrations up to 1 %, travels to the kathode, also in the presence of acid or alkali of 0·1 %. Purified gelatin (0·4 to 1·68 %) travels to the kathode when the $pH \leq 4{\cdot}6$, to the anode when the $pH \geq 4{\cdot}9$; the isoelectric point lies near 4·75. In mixtures of the two, both the constituents travel together as long as the gelatin predominates, as if the blue were absent; with 0·51 % of gelatin and 0·007 % of the blue the relations are altered, and in decidedly acid solutions the gelatin and blue may together travel to the anode, while the blue alone may also go to the kathode. The diffusion tests [see Abstract 1139 (1926)] are made by pouring the solution of the blue, with or without additions, on the congealed gelatin. When the additions are acids or acid salts, the diffusion downwards proceeds unchecked; when they are alkaline (sometimes also neutral), the blue accumulates in a dark ring and stops there. The spectrometric experiments do not show particular absorption at the characteristic pH point. The gelatin seems to adsorb the blue after the manner of animal charcoal; in a deep layer of gelatin the rate of diffusion follows the partition rule, for a thin layer an exponential law holds. H. B.

1345. Application of the Langmuir Theory to the Adsorption of Gases by Charcoal. M. Polanyi. *Zeits. f. phys. Chem.* 138. *Abt. A.* 6. *pp.* 459–462, *Dec.*, 1928.

Zeise [see Abstract 319 (1929)] has recently preferred an explanation of the adsorption of gases by charcoal based on Langmuir's theory. The present author now discusses a series of cases in which the Langmuir formula accounts for the adsorption isotherms, although explanations are not possible on the Langmuir theory. The agreement found by Zeise is consequently opined to be accidental. H. H. Ho.

1346. Rate of Adsorption of Mixtures of Gases Containing Alcohol and Ether in Addition to Air by Different Silica Gels. L. v. Putnoky and G. v. Szelényi. *Zeits. f. Elektrochem.* 34. *pp.* 805–813, *Dec.*, 1928.

A dynamic method for following the adsorption of alcohol and ether by different silica gels was developed. The vapours of alcohol and ether were carried by a stream of air through a tube filled with glass beads to ensure thorough mixing. The gas was then passed to the chamber of a suitable interferometer, and its composition was determined. The composition was again determined after the gas mixture had been passed over the silica gel and then into another chamber of the interferometer. The determinations were carried out at a temperature of 20° C. The ordinary silica gel of commerce and a silica gel were prepared by the hydrolysis of silicon tetrachloride. The vapours of alcohol and ether are simultaneously adsorbed by the silical gel. It was shown that all the silica gels used adsorbed the same quantity of vapour from each definite degree of "carburetting." The rate of adsorption falls off as the end of the process is reached, but for the silica gels tried, the alcohol ether ratio of the adsorbed vapours remained practically constant from the beginning to the end of the adsorption. F. J. B.

1347. Process of Adsorption. W. Kälberer and H. Mark. *Zeits. f. phys. Chem.* 139. *pp.* 151–162, *Dec.*, 1928.

The results of experiments with different preparations of silicic acid show that, with many such preparations, the adsorption isotherms of both argon and carbon dioxide exhibit considerable initial linear portions. Other preparations show, for very low layer-densities, at first a steep rise in the isotherm, this passing into a straight line. In the linear parts, the heat of adsorption is 2500 cal. for argon and 6200 cal. for carbon dioxide; for one sample of silicic acid, the mean heat of adsorption for the steep portion of the curve is 500 cal. for carbon dioxide. In the adsorption of carbon dioxide at various temperatures by aluminium foil of known surface, the thickness of the adsorption layer is of the order $1 \cdot 5 \times 10^{-8}$ cm. T. H. P.

1348. Adsorption. Marie T. Isselstein. *Phys. Zeits.* 29. *pp.* 873–878, *Dec.* 1, 1928.

This paper records an investigation of the adsorption of carbon disulphide, pentane and chloroform by glass powder. For this purpose the surface area of the glass powder has been ascertained by the process of Schmidt and Durau as modified by Schelte. The adsorbed vapour layers amount to a coating attaining as much as thirty-five molecular thicknesses, but which decreases under reduced pressures. The results when compared with existing data show that the magnitude of the gaseous adsorption is related to the condensation capacity. H. H. Ho.

1349. Siloxen as Adsorbent. H. Kautsky and G. Blinoff. *Zeits. f. phys. Chem.* 139. *pp.* 497–515, *Dec.*, 1928.

In this paper siloxen is investigated as an adsorbent, although its structure is discussed and shown to correspond to a chemically and morphologically defined individual more simple than that of other adsorbents. Polar capillary active substances with long carbon chains, when mixed with siloxen, experience pronounced loosening of the lamellar structure. In contrast to other adsorbents, differently prepared specimens of siloxen afford always only one adsorption isotherm with respect to a definite adsorptive. Specific weight determinations (by a special method) give definite values in contrast to charcoal because of the simple structure. Siloxen is a very good adsorbent which in aqueous solutions can adsorb many apolar organic substances, and the isotherms for fatty acids are included in the paper, these being in good agreement with the Traube rule. Oxidised siloxens exhibit interchange adsorption with respect to aniline hydrochloride, only the positive ions being fixed. H. H. Ho.

1350. Influence of Gases on the Electric Double Layer of Aqueous Solutions. A. Bühl. *Ann. d. Physik*, 87. 7. *pp.* 877–908, *Dec.* 8, 1928.

According to Lenard, 1910, the double layer is entirely in the liquid, not partly in the gas. The negative charge of the air near water-drops is due to the invisible, minutest particles torn off the drops. The author experiments with chains of the type; calomel | solution 1 | air | solution 2 | solution 1 | calomel, the liquids being discharged from small orifices. Of the five potential differences, I and V would balance out, IV (diffusion potential) is known, so that the sum of II and III can be determined and, by changing the concentrations of the solutions, also the two terms of the sum. The gases N_2, O_2, H_2 do not influence the conductance of water or of alkali chloride solutions even after continued bubbling with the gas; thus gas ions are not present. Experiments with CO_2 gave discordant results. But dissolved gases raise the potential difference of the double layer, particularly with increasing dilution of the salt solutions; the curves both for the different gases and the different salts cross one another. Solutions of LiCl are less effective than KCl and NaCl. The effects are slight and not instantaneous, the gas adsorbed forming first an electrically ineffective capillary layer. The surface layer of a drop of pure water or of a salt solution is negatively charged to a depth of about 20 molecules, 80×10^{-8} cm.; all particles torn out of this layer carry negative charges. Underneath, to about the same depth, the charge is positive [see Busse, Abstract 1702 (1925)]. There are really three layers: a negative film, below it a positive film of double the charge, and again a negative layer. H. B.

1351. Solubility and Velocity of Solution of Solid Bodies. E. N. Gapon. *Zeits. f. Elektrochem.* 34. *pp.* 803–805, *Dec.*, 1928.

The theory of Noyes and Whitney on the velocity of solution of solid bodies is discussed, and connected to the more recent work of Drucker. It is concluded that the Noyes-Nernst theory leads to the following conclusions: The critical increment of the velocity of solution depends on the nature of the solvent only, and is equal to the value obtained from the equation of Drucker, W + RT. The solution velocity constant changes parallel with the fluidity of the solvent. F. J. B.

1352. Electrical Double Layer in Colloids, Silver Iodide Sol. H. R. Kruyt and P. C. van der Willigen. *Zeits. f. phys. Chem.* 139. *pp.* 53–63, *Dec.*, 1928.

The peptonising of the sol of silver iodide by a series of salts was determined. The salts were: KI, KBr, KCl, KCN, KCNS, KNO_3, K_2SO_4, K_2CO_3, K_2HPO, $K_2Cr_2O_7$ and $K_3Fe(CN)$. Three series of experiments were made in which the end concentration of the peptonising electrolytes were 0·05, 0·1 and 0·5 milli-mols. per litre. The effects on accurately measured quantities of silver nitrate and potassium iodide were recorded by photographing the mixtures after two and after seven days. The results show that in all probability the double layer is due to space lattice forces, especially from the relationship between the peptonising power and the isomorphy of the peptonising ions. F. J. B.

1353. Mechanical Coagulation as a Coagulation on Boundary Surfaces. H. Freundlich and S. Loebmann. *Zeits. f. phys. Chem.* 139. *pp.* 368–374, *Dec.*, 1928.

The mechanical coagulation of goethite was investigated. The sol was prepared by treating iron carbonyl with hydrogen peroxide, and the particles consisted of $\mathrm{FeO(OH)}$. The coagulation showed great similarity to that obtained with the sol of copper oxide. A marked difference was that only a certain fraction of the colloidal particles were coagulated by stirring. Air bubbled through the solution of goethite, or shaking with benzene also brought about coagulation. All the evidence obtained was in favour of the view that coagulation took place at the boundary surface between liquid and air. F. J. B.

1354. Electrical Moment of Colloidal Vanadic Anhydride. J. Errera. *J. de Physique et le Radium*, 9. *pp.* 307–309, *Oct.*, 1928.

Calculates the electric moment of the rodlets of vanadic anhydride, which he finds to be 415×10^{-18}, or several hundred times greater than the moment of ether, water, or nitrobenzene. He assumes that in certain colloids there is a formation of specially large colloids and also an arrangement of molecules calculated to produce specially large electric moments. E. E. F. d'A.

1355. Use of Internal Pressure in Metallic Systems. System Lead, Antimony, Copper. R. A. Morgen. *Science*, 68. *pp.* 490–491, *Nov.* 16, 1928.

The internal pressure is defined by Dupré as being equal to $(-\mathrm{T}\alpha/\beta)$, where T is the absolute temperature, α the coefficient of expansion, and β the coefficient of compression. Liquids with like internal pressures appear to be more easily miscible then those with unlike. Other important points are melting points, heats of fusion and the stability of any compounds formed. Considers in detail the relations between lead, antimony and copper as a ternary system, studying the shape of the immiscibility gap. H. N. A.

1356. Some Physical Properties of Pure Carbon-Free Chromium-Iron and Vanadium-Iron Alloys. K. Ruf. *Zeits. f. Elektrochem.* 34. *pp.* 813–818, *Dec.*, 1928.

A series of measurements were made to determine the specific resistance, the temperature coefficient of the specific resistance, the thermo-electromotive force, the specific gravity (density) and the coefficient of expansion, of chromium-iron and vanadium-iron alloys. The results of the determinations were drawn as graphs, and considerable deviations from the values recorded in the literature were observed. F. J. B.

1357. Determination of the Rôle of Light in Thermochemical Reactions. J. Perrin. *Comptes Rendus*, 187. *pp.* 913–916, *Nov.* 19, 1928.

The theory of the activation of the molecules by the absorption of a quantum of energy and its bearing on the subsequent reaction which takes place are discussed, as well as a theory for the phenomenon of fluorescence, based upon the bombardment of the system by radiations of a particular wave-length and intensity, and the theory is connected to the one of activation. As a result, the effect of light on a reaction which is purely thermal is considered to render the reactants fluorescent in whatever state they exist. F. J. B.

1358. Quenching of Cadmium Resonance Radiation. J. R. Bates. *Nat. Acad. Sci., Proc.* 14. *pp.* 849–852, *Nov.,* 1928.

This work attempts to explain the differences in effect on the activation of hydrogen molecules by the energy radiations of cadmium and mercury respectively in the 2^3P state [see Abstract 2014 (1928)]. The results obtained seem to confirm the statement often seen that the thermal activation of the reactants is often of minor importance in causing reactions to take place. This activation may often be the result of the activation of some catalytic substance present as an impurity. The author found that the activation of hydrogen amounting to 87,000 calories does not lead to the reaction $H_2 + C_2H_4 \rightarrow C_2H_6$, though exothermal. J. K.

1359. Variation of the Extinction Coefficient with Temperature. B. K. Mukerji, A. K. Bhattacharji and N. R. Dhar. *J. Phys. Chem.* 32. *pp.* 1834–1840, *Dec.,* 1928.

In various photochemical reactions, even when all other conditions are precisely the same, the photochemical yield per quantum changes markedly with change in the temperature at which the reactions are investigated. It is difficult to explain this phenomenon unless it be assumed that the quantity of the light energy of a particular type absorbed by the system also changes with temperature. In each of fifteen cases examined, it is found that the extinction coefficient increases with rise in temperature of the solution, a rise of 30° sometimes causing three-fold increase; hence the amount of light absorbed does increase considerably with rise of temperature. In all cases the extinction coefficient is a linear function of the temperature. These results are explainable by changes in the hydration of the solutes at the higher temperatures. Usually the complexity of solvates is diminished by raising the temperature, and this frequently leads to changes in absorption, the bands becoming broader as the solvates become simpler. Increase in the concentration of the solute produces in general the same effect as raising the temperature. T. H. P.

1360. Surface Oxidation of Aluminium, Tungsten and Molybdenum. L. C. Bannister. *Chem. Soc., J. pp.* 3163–3166, *Dec.,* 1928.

The colours on anodes of aluminium and various other metals have been regarded as interference tints, although the sequence of colours obtained on tungsten by anodic treatment has been attributed to the formation of different oxides. Results are now given of investigations on the colours obtained by anodic treatment or by heating in air, and the conclusion is drawn that the film on the metal is an oxide film of variable thickness which can cause interference of light in the visible region of the spectrum and so cause colour. In the case of aluminium, when phosphate or other acid radicle is present in the electrolyte used, this becomes occluded or held in suspension in the pores of the film. T. H. P.

1361. Interference of Vibrations as the Cause of Energy Variations and Chemical Changes. M. Polanyi and E. Wigner. *Zeits. f. phys. Chem.* 139. *pp.* 439–452, *Dec.*, 1928.

Previous investigations have shown that the velocity constant of monomolecular reactions in solutions or gases contains, together with an exponential factor, also a magnitude which is always of the same order of magnitude, namely, 10^{14}. In order to explain this, it is now suggested that the energy in the molecule varies up and down in elastic waves and that chemical change may occur if, by interference of these waves, the amplitude at a certain linking exceeds a critical value. This view leads to the expression $\nu e^{-Q/RT}$ for the velocity constant, ν being the frequency of the atomic vibration; such expression has the order of magnitude required. T. H. P.

1362. Determination of Attraction Forces from the Chemical Equilibria of Condensed Systems. R. Lorenz. *Zeits. f. phys. Chem.* 139. *pp.* 1–11, *Dec.*, 1928.

The condensed systems of van't Hoff are inhomogeneous systems consisting only of liquid or solid (not gaseous) components. For these systems the law of mass action represents an isothermal of a state in which all the components are below their boiling points, so that van der Waals' formulæ are strictly applicable. They lead directly to affinity and valency relations. The paper discusses particularly the proper volumes and attraction (cohesion) of atoms and molecules in fused mixtures of the metals Cu, Ag, Zn, Cd, Sn, Pb and their halides. The a and b are not those of van Laar, but are mole volumes in cm.^{3}. The a are deduced from vapour pressure data. If atoms of fused lead attract one another with the force a_1, the atoms of cadmium with the force a_2, then, on mixing the two melts, the attractive force a_{12} between the two kinds of atoms may be equal to, greater or smaller than $\sqrt{a_1a_2}$. If greater, the excess attraction would indicate a tendency to combination of the two atoms. There was an excess in all the equilibria studied, the greatest difference being observed in the case of Zn and Cd at 600°, where $a_{12} = 2 \cdot 39 \times 10^7$, and $\sqrt{a_1a_2} = 1 \cdot 26$, and the difference $1 \cdot 13$ expressed in the same unit. H. B.

1363. Molecule and Constitution of Hypophosphoric Acid. A. Rosenheim and H. Zilg. *Zeits. f. phys. Chem.* 139. *pp.* 12–21, *Dec.*, 1928.

Different determinations of the molecular weight of hypophosphoric acid have led to contradictory results. The aqueous solution of the acid decomposes into phosphorous acid and phosphoric acid. This reaction, like the saponification of the esters of the acid, is very slow at ordinary temperature, but has a very high temperature coefficient and is reversible and dependent upon the hydrogen-ion concentration. The authors find that this decomposition of the hypo-acid into phosphorous and phosphoric acids is monomolecular according to $H_4P_2O_6 + H_2O \leftrightarrows H_3PO_3 + H_3PO_4$, and not bimolecular according to $2H_2PO_3 + H_2O \leftrightarrows H_3PO_3 + H_3PO_4$. The molecule of the hypophosphoric acid would, therefore, be $H_4P_2O_6$, which is, however, in contradiction to the determinations based upon the study of the esters. Structurally the hypo-acid seems to be a compound of tetravalent phosphorus. The study of some new compounds prepared shows that the analogy between the hypo-acid and the pyrophosphates is not complete. H. B.

1364. Reactions between Atomic Hydrogen and Hydrocarbons. K. F. Bonhoeffer and P. Harteck. *Zeits. f. phys. Chem.* 139. *pp.* 64–74, *Dec.*, 1928.

The behaviour of free hydrogen with a number of different hydrocarbons was investigated. The hydrogen was activated in a Wood's discharge tube, and was mixed with the hydrocarbons in such proportions that for each molecule of hydrocarbon there were several molecules of hydrogen. The reaction products were led through three cooling vessels, in which the various products were separated. The results showed that free atoms of hydrogen reacted with the hydrocarbons in three different ways, *viz.*, dehydrogenising, hydrogenising or a breaking up of the chain in a similar way to "Cracking." The hydrocarbons investigated were: methane, ethane, pentane, ethylene, acetylene and benzene. F. J. B.

1365. Explosions in Closed Cylinders. Methane-Air Explosions in a Long Cylinder. Effect of the Length of the Cylinder. Parts I–II. W. A. Kirkby and R. V. Wheeler. Part III. Manner of Movement of Flame. O. C. de C. Ellis and R. V. Wheeler. *Chem. Soc., J. pp.* 3203–3218, *Dec.*, 1928.

Part I.—Experiments are carried out to correlate the movement of flame with the development of pressure during explosions in a closed cylinder having a length much greater than the diameter. The cylinder is filled with the required mixture kept in a gas-holder over glycerol and water. Ignition is effected by a single secondary discharge from an 8-in. induction coil, produced by breaking a current of 5 amperes in the primary circuit. The moment of ignition is recorded on a pressure chart and on photographic paper, the speed of revolution of both drums being attained by means of a tuning-fork of 50 frequency. The important factor found to govern the pressure produced is the time taken for the flame to travel throughout the mixture.

Part II.—It is found that the time of explosion does not increase proportionally with the length of the cylinder. It is less by so much as the mean speed of the flame is greater in the longer cylinders. The greater speed is due to the greater freedom of movement.

Part III.—The movement of flames studied by means of "snapshot" photographs on a stationary plate are shown to be of use in explaining some of the phenomena of explosions. The photographs in this paper are for carbon monoxide and oxygen because flames so produced have high actinic value. The manner of the movement of flame in methane-air mixtures is, however, essentially the same. J. K.

1366. Intermediate Products of the Combustion of Methane. E. H. Riesenfeld and D. Gurian. *Zeits. f. phys. Chem.* 139. *pp.* 169–197, *Dec.*, 1928.

In the flame reaction between methane and oxygen the following intermediate products have been established: formaldehyde, carbon monoxide, hydrogen peroxide and ozone. From the dependence of the concentrations of the latter upon the reaction conditions, it is concluded that the primary process of methane decomposition is into methene and atomic hydrogen. The methene burns partly to formaldehyde and partly to carbon monoxide. The atomic hydrogen forms hydrogen peroxide to a small extent but mainly molecular hydrogen. The ozone arises by the decomposition of the hydrogen peroxide with liberation of atomic oxygen, but again decomposes during slow cooling. The further oxidation of formaldehyde, carbon monoxide and hydrogen produces carbon dioxide and water. H. H. Ho.

1367. Formation of Hydrazine in the Decomposition of Ammonia in Electrical Discharges. G. Bredig, A. Koenig and O. H. Wagner. *Zeits. f. phys. Chem.* 139. *pp.* 211–223, *Dec.*, 1928.

Results are given of investigations on the formation of hydrazine during the electrical decomposition of ammonia, which is known to take place in stages. Both the Siemens tube glow discharge under diminished and atmospheric pressure, and strongly cooled high-tension arcs at diminished pressure, with alternating and direct current, were used. Low electrical efficiency densities and high gas-current velocities are found to be favourable to the formation of hydrazine. The predominance of the Schuster bands in the arc spectrum serves as a criterion of a good yield. T. H. P.

1368. Homogeneous Catalysis. *Faraday Soc., Trans.* 24. *pp.* 545–696, *Nov.*; *Disc., pp.* 697–737, *Dec.*, 1928.

A general discussion of the subject under the three headings: Part I, "General Relations"; Part II, "Intermediate Addition-Compounds and Chain Reactions"; and Part III, "Neutral Salt and Activity Effects," comprising the following twenty papers, together with an introductory paper, "Some Problems in Homogeneous Catalysis," by **T. M. Lowry.**

Part I.—"Homogeneous Catalysis," by **C. N. Hinshelwood;** "Influence of Nitrogen Peroxide on the Union of Hydrogen and Oxygen. Problem of 'Trace Catalytis'," by **C. H. Gibson** and **C. N. Hinshelwood;** "Catalytic Phenomena in the Tautomerism of Certain α-Diketones," by **H. Moureu;** "Ionisation in Chemical Change," by **N. R. Dhar;** "Negative Catalysis in Slow and Induced Oxidations," by **N. R. Dhar;** "Inhibition in Chemical Reactions," by **E. K. Rideal;** "Phosphorescence and Autocatalysis during Slow Combustion," by **F. Gill, E. W. J. Mardles and H. C. Tett.**

Part II.—"Intermediate Addition-Compounds and Chain Reactions. Compound Formation in Ester-Water Systems," by **J. Kendal** and **Lilian E. Harrison;** "Report on the Theory of Chain-Reactions," by **J. A. Christiansen;** "Mechanism of Inhibition in Auto-Oxidation Reactions," by **H. L. J. Backström;** "Inhibition of Chain Reactions by Bromine," by **M. Polanyi;** "Theory of Molecular Dislocation Applied to Homogeneous Catalysis," by **J. Böeseken;** "New Case of Photochemical Catalysis. Reaction between Nitric Oxide and Cyanogen and its Mechanism," by **R. G. W. Norrish** and **F. F. P. Smith.**

Part III.—"Neutral Salt and Activity Effects. Theory of Acid and Basic Catalysis," by **J. N. Brönsted;** "Catalytic Effects of Acids and Bases and Influence of Inert Salts," by **H. M. Dawson;** "Compounds between Catalysts and Substrates and their Reactivity," by **H. v. Euler;** "Investigations of Salt Action on Homogeneous Catalysis," by **H. S. Harned** and **G. Åkerlöf;** "Keto-Enol Isomerism and Mechanism of Homogeneous Reactions," by **F. O. Rice** and **J. J. Sullivan;** "Determination of the Catalytic Coefficient of the Hydroxyl Ion in the Mutarotation of Glucose and Lactose," by **T. M. Lowry** and **G. L. Wilson;** "Kinetics of Acid and Basic Catalysis," by **A. Skrabal.**

1369. Formation of Ozone by Kathode Rays. A. L. Marshall. *Am. Chem. Soc., J.* 50. *pp.* 3178–3197, *Dec.*, 1928.

A kathode-ray tube installation is described which can be conveniently used for studying the effects of high velocity electrons on pure and mixed gases. The ozonisation of oxygen is shown to occur wholly in the gas phase and to be uninfluenced by the nature of the walls of the containing vessel. 50 % of the reaction takes place in a volume within 2 cm. of the tube window, although the kathode rays have a range of 20 cm. under these conditions. Ozone is both formed and decomposed under the influence of the kathode rays, and with continued raying a steady state is reached with an ozone concentration of 1 mol. to 1700 of oxygen, which is independent of the tube current. Compares the concentration of 1 in 12 with the silent discharge. It has not been found possible to check the results of Krüger and Utesch, who determined the amount of ionisation by a saturation current method. H. H. Ho.

1370. Combination of Hydrogen and Oxygen under the Influence of Kathode Rays. A. L. Marshall. *Am. Chem. Soc., J.* 50. *pp.* 3197–3204, *Dec.*, 1928.

A method is developed for analysing gas mixtures containing small quantities of hydrogen peroxide, water vapour and ozone. In the reaction between hydrogen and oxygen under the influence of kathode rays it is shown that peroxide, water vapour and ozone are formed as primary products. A kinetic study at varying concentrations of hydrogen and oxygen shows that the rate of peroxide formation is almost independent of concentration, whereas the rate of water-vapour formation varies over a five-fold range, and ozone over a ten-fold range. The rates of formation of ozone and water vapour parallel one another very closely at all the concentrations studied, suggesting that the same primary mechanism is responsible for the formation of both. The gross rate of reaction parallels that observed by Lind for the same reaction under the influence of *a*-particles. H. H. Ho.

1371. Equilibrium between Aluminium Carbide and Nitrogen at High Temperatures. C. H. Prescott, Jr., and W. B. Hincke. *Am. Chem. Soc., J.* 50. *pp.* 3228–3237, *Dec.*, 1928.

Apparatus and methods adopted in the study of chemical equilibria at incandescent temperatures at pressures of 0·01 mm. are fully described. From the experimental deductions made for the reaction $4AlN + 3C = Al_4C_3 + 2N_2$ calculations are made for the reaction $Al_2O_3 + 3C + N_2 = 2AlN + 3CO$. J. K.

1372. Apparatus for Micro Gas Analysis. C. H. Prescott, Jr. *Am. Chem. Soc., J.* 50. *pp.* 3237–3240, *Dec.*, 1928.

It was necessary in the carrying out of measurements on the equilibrium between aluminium carbide and nitrogen to analyse quite small quantities of gas to determine the partial pressure of nitrogen. Apparatus is described here which was designed to operate on samples whose volumes would be a third of a cubic centimetre or less at one atmosphere, and to determine carbon dioxide, carbon monoxide, hydrogen and nitrogen. Carbon dioxide is absorbed in soda lime; carbon monoxide and hydrogen are oxidised by copper oxide at 250° and the water is absorbed in phosphorous pentoxide. [See preceding Abstract.] J. K.

1373. Equilibrium of Silver Oxide and Chloride with Potassium Hydroxide and Chloride. R. F. Newton. *Am. Chem. Soc., J.* 50. *pp.* 3258–3261, *Dec.*, 1928.

The ratio of chloride to hydroxide ions in solutions saturated with silver oxide and chloride is 0·00905 at M/10 and 0·00897 at M/20. The weighted mean is 0·00903. T. M. L.

1374. Thermodynamic Study of Fundamental Corrosion Reactions. W. J. Sweeney. *Am. Electrochem. Soc., Trans.* 53. *pp.* 317–327; *Disc.*, 327–331, 1928.

The fundamental corrosion reactions of iron in the absence of oxygen and the iron-ferrous ion-hydrogen, ion-hydrogen equilibrium are discussed from an electromotive and free energy standpoint. From a critical survey of the literature on the solubility of iron and of ferrous hydroxide, a solubility product of $10^{-18 \cdot 8}$ and a provisional value of − 120,920 calories for the free energy of formation from the elements of ferrous hydroxide are obtained. With this value at hand the conclusion is drawn that there is a small free energy decrease for the attack of iron by water to form ferrous hydroxide and hydrogen even in the absence of oxygen. The interdependence of the iron, ferrous ion, hydrogen ion, hydrogen equilibrium and the ferrous hydroxide equilibrium is also pointed out. AUTHOR.

1375. Corrosion, Residual Current and the Passive State. F. Tödt. *Zeits. f. Elektrochem.* 34. *pp.* 853–857, *Dec.*, 1928.

In previous papers the author had dealt with the relationship between the residual oxygen current and the solution and deposition of metals [see Abstract 641 (1929)]. Continuing this work, it was shown that when two different noble metals were placed in the same solution, the current strength was a measure of the corrosion of the less noble metal. This method can be applied as a means of measuring the corroding power of a solution, instead of the more usual gravimetric methods. It has the advantage of rapidity and simplicity, so that it is possible to follow the progress of the corrosion, and also of the factors which prevent or retard the corrosion, such as the formation and removal of protective surface layers. The method also is a sharp indication of the passive state of metals. F. J. B.

1376. Retardation and Prevention of Oxidation. J. G. A. Rhodin. *Engineer,* 147. *pp.* 66–68, *Jan.* 18, *and pp.* 92–93, *Jan.* 25, 1929.

A critical account of the paper on "Negative Catalysis of Auto-Oxidation or Anti-Oxygenic Activity," by Moureau and Dufraisse (*Chemistry and Industry*, 47. pp. 819–828 and 848–854, 1928), with whose peroxide theory the author is not in entire agreement. He also discusses the very lasting black coating of (probably) magnetic oxide formed on certain specimens of iron, and suggests experiments to test the action of water vapour on iron at various temperatures, but the paper contains no original observations save that pure rubber piping through which electrolytic oxygen passes without removal of ozone perishes in a few minutes, whereas vulcanised rubber stands the action fairly well; and that "knocking" in internal-combustion engines can be stopped by "simple valve adjustment and attention to temperature." C. A. S.

1377. Osmosis of Ternary Liquids. General Considerations. F. A. H. Schreinemakers. *K. Akad. Amsterdam, Proc.* 31. 8. *pp.* 811–822, 1928.

A mathematical paper, in which the possible number of types of diffusion is discussed. T. H. P.

1378. Electrocapillary Curves of Mercury. A. Frumkin and A. Obrutschewa. *Zeits. f. phys. Chem.* 138. 3–4. *pp.* 246–250, *Nov.*, 1928.

These authors are unable to confirm the maximum positions in the electrocapillary curves given by Bennewitz and Delijannis [see Abstract 1942 (1927)]. J. K.

1379. Electrode Potential of Nickel. Mechanism of the Re-Activation of the Passive State of Nickel. K. Murata. *Chem. Soc. Japan, Bull.* 3. *pp.* 267–276, *Nov.*, 1928.

In this paper the experimental results recorded in two earlier papers [see Abstracts 2239 and 2528 (1928)] are discussed upon thermodynamical grounds, and also the reactivation by hydrogen of nickel, previously affected by oxygen, is explained on the assumption that the nickel itself catalyses the reaction of oxygen with the hydrogen. J. K.

1380. Incompatibility between any Theory of Complete Dissociation and Migration Data for Divalent Ions. J. W. McBain and P. J. van Rysselberge. *Am. Chem. Soc., J.* 50. *pp.* 3009–3017, *Nov.*, 1928.

Measurements of the migration of cadmium, magnesium, lithium, potassium and calcium were made in 0·05 M solutions of one of their salts containing at least one divalent ion. The results showed that when a sufficient excess of chlorine ions or sulphate ions was added to 0·05 M solutions of salts containing a divalent ion, the migration of the anion was suppressed or reversed, showing that the sulphate or chlorine ions had combined with undissociated molecules to form complex ions. Such migration is incompatible with the assumption that salts containing polyvalent ions are completely dissociated, except in extreme dilution. F. J. B.

1381. New Thermochemical and Refractometric Investigations in the Field of Strong Electrolytes. E. Lange. *Phys. Zeits.* 29. *pp.* 760–769; *Disc.*, 769–770, *Nov.* 1, 1928. *Paper read before the Deut. Naturforscher u. Ärzte, Hamburg, Sept.*, 1928.

The thermochemical properties of solutions of electrolytes were determined in a specially designed calorimeter. The calorimeter works on the differential principle and is capable of measuring adiabatic changes. The integral heat of dilution of dilute solutions of electrolytes was measured in the calorimeter, which was capable of very extreme accuracy. The heats of dilution of the solutions of the salts of the alkali metals were determined at 25° C. The results at great dilution confirmed the Debye-Hückel calculation of the heats of dilution. The refractometric measurements, as well as the thermochemical measurements, supported the assumption that undissociated molecules existed in solutions of strong electrolytes, a conclusion which was not previously supported either by thermochemical or optical criteria. F. J. B.

1382. Prevention of Polymerisation between Discharged Ions in the Persulphate Process. O. Essin. *Zeits. f. Elektrochem.* 34. *pp.* 758–760, *Nov.*, 1928.

The conditions for the prevention of the polymerisation of the SO_4'' ions in the formation of persulphate and the distance between the ions for the avoidance of persulphate formation is discussed and calculated. As a result it was found that, subject to the assumption of a layer of active ions at the electrode, the distance at and below which the polymerisation of the SO_4 ions can form persulphate is of the order of 10^{-6} cm.

F. J. B.

1383. Electrochemistry of Solutions of Phosphorus Pentachloride in Bromine. W. A. Plotnikow and Sophie Jakubson. *Zeits. f. phys. Chem.* 138. 3–4. *pp.* 235–242, *Nov.*, 1928.

The authors show that solutions of phosphorous pentachloride in bromine have a characteristic electrical conductivity, the magnitude of which approaches closely to that of typical electrolytes in aqueous solution. Depending on the concentration the specific electrical conductivity reaches a maximum value. Depending on the dilution the molecular conductivity reaches at first a maximum and then approaches a minimum. Electrolytic investigations show that anodic chlorine is evolved in quantities approximating to Faraday's law. The relationship between current strength and voltage is given by a straight line. Ionic decomposition gives a polymerised polybromide $n\mathrm{PCl}_5 \,.\, m\mathrm{Br}_2 \,.\, \mathrm{PCl}_5 \,.\, 5\mathrm{Br}_2$ which has been shown to exist by thermo-analysis.

J. K.

1384. Relationship between Osmotic Coefficients and Chemical Structure of Ions in Tetraalkyl Ammonium Salts. L. Ebert and J. Lange. *Zeits. f. phys. Chem.* 139. *pp.* 584–596, *Dec.*, 1928.

The authors have investigated cryoscopically various salts of the NR_4 bases in ranges of 0·05 to 1 molecule. These show, in comparison to the inorganic salts so far investigated, a distinct individual behaviour. The various curves form into no group. It is not possible to classify the various salts according to any characteristic such as the dissociation constant. The salts $N(C_3H_7)_4I$ and $N(C_2H_5)_4I$ show of all the representatives of the simplest valency type the least lowering in the freezing point and promise, therefore, the distinct information necessary for estimating the value of the different proposed theories on strong electrolytes.

J. K.

1385. Furfural as a Possible Ionising Medium. J. R. McKee, C. A. Mann and G. H. Montillon. *Am. Electrochem. Soc., Trans.* 53. *pp.* 333–349; *Disc.*, 349–350, 1928.

Technical furfural was carefully purified and stabilised by the addition of small amounts of pyrogallol. Preliminary qualitative conductivity measurements of solutions of eighteen inorganic salts in this solvent, showed that the halides gave the best results, and of these the iodides of potassium and ammonium were the most satisfactory. Quantitative measurements confirmed these conclusions. Mixtures of cuprous iodide with ammonium or potassium iodide in furfural gave increased values. Zinc iodide behaved similarly. Copper, zinc and silver were plated from solutions of the metal iodide with ammonium iodide in furfural.

AUTHORS.

1386. Electrical Conductivities of Compressed Mixtures of Salts. P. Fischer. *Zeits. f. Elektrochem.* 34. *pp.* 756–758, *Nov.*, 1928.

In a previous paper a method for determining the electrical conductivity of compressed mixtures of two salts was described. Continuing the investigation, the conductivity of mixtures of three salts was determined. Mixtures of iodides of lead, mercury and potassium, and of cadmium, lead and potassium, and of cadmium, lead and silver were compressed into cylinders and the conductivities were measured. The conductivities of the binary and ternary mixtures were determined and compared. F. J. B.

1387. Electrical Conductivities of Univalent Salts in Benzonitrile. Evidence for the Incomplete Dissociation of Strong Electrolytes and Applicability of the Law of Mass Action to their Dissociation. A. R. Martin. *Chem. Soc., J. pp.* 3270–3293, *Dec.*, 1928.

Debye and Hückel's theory is referred to. Benzonitrile is chosen as solvent because it is easily purified, it is inert and non-hygroscopic, its boiling point is fairly high and because it is less closely related to water than the alcohols. The conductivity values of the iodides of lithium, sodium and potassium, of lithium bromide and of silver nitrate in this solvent are given for a range of dilution of N/500 to N/10,000 or N/50,000 and for a temperature range of 0° to 70°. The viscosity values of benzonitrile over the same range of temperature are also given. Extrapolation to Λ_0 is carried out by the square root law and by Ferguson's method. For almost the whole range of temperature Λ_0 is directly proportional to the fluidity of the solvent. The conductivity-concentration curve is described by a dissociation governed by the law of mass action, the Coulomb forces between the ions at high concentrations being taken into account. In extremely dilute solutions dissociation is complete.

J. K.

1388. Ionic Concentrations and Activity Coefficients of Weak Electrolytes in Certain Salt Solutions. H. S. Harned and R. A. Robinson. *Am. Chem. Soc., J.* 50. *pp.* 3157–3178, *Dec.*, 1928.

A method has been discussed whereby the activity coefficients and dissociation of weak acids and bases in salt solutions may be computed from the electromotive forces of cells without liquid junctions containing easily reproducible electrodes. This method has been employed to obtain the activity coefficient of acetic acid in potassium-, sodium-, lithium-, and barium-chloride solutions. A modified method employing cells with negligible liquid junction potentials was employed for the determination of the activity coefficients of the bases. The ionic activity coefficients of acetic, mono- and dichloro-acetic acids are less in the solution of a given strength of that salt which possesses the higher activity coefficient in pure water. The same is true for ammonia and monomethylamine, and the order agrees with that found for the ionic activity coefficients of water being the reverse of the order found for the activity coefficients of halide acids in salt solutions. The effect of the change in the solvent caused by large quantities of the undissociated molecules has been discussed and approximately computed. The method here employed should prove very useful for studying salt effects in organic and biological media.

H. H. Ho.